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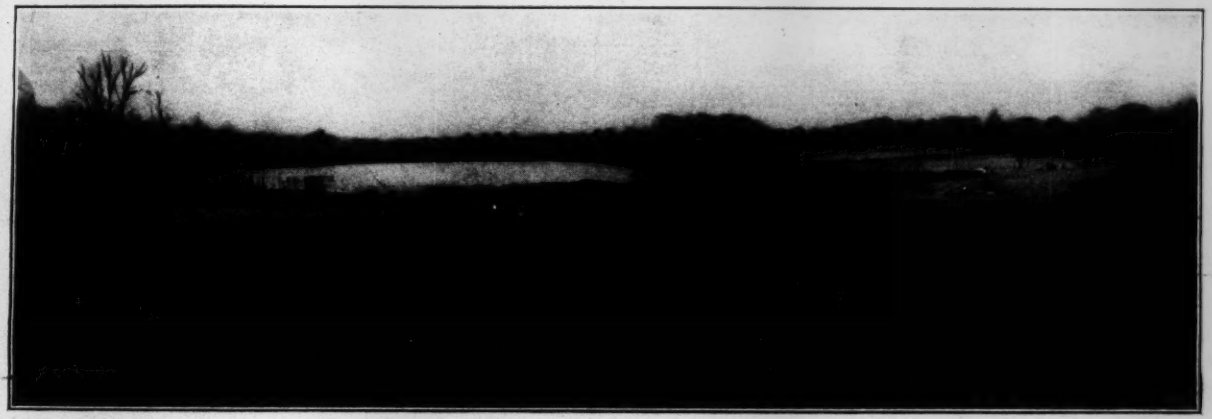
The Silver Lake Reservoir of the Catskill Water Supply System, New York City

By Orrin L. Brodie*

The southern terminal of the new Catskill Aqueduct, for the water-supply of New York City, will be Silver Lake Reservoir, on Staten Island (or the Borough of Richmond), New York City; for although the city aqueduct tunnel proper ends in the Borough of Brooklyn, the Catskill water will be carried under the Narrows in New York Harbor in a 36-in. pipe to this terminal reservoir. The contract for the construction of the reservoir and a pressure tunnel leading to it, Contract 89, was let on Aug. 19, 1913, and work was begun Sept. 6 following. The time allowed for completion is three years.



Upper View, North Dike Site; Lower View, West Dike Site, Silver Lake Terminus of the Catskill Aqueduct

Reservoir Site—Silver Lake Reservoir (Fig. 1) is situated just west of Richmond Turnpike, about two miles southwest of the St. George ferry terminal. The site includes the existing Silver Lake and is in a public park. The plan, Fig. 1, shows the completed reservoir as projected. The accompanying illustrations give a general plan and elevations of the gate chamber and inlet channels, typical cross-sections of the tunnel, shallow flowage-excavation profile and dike cross-sections. The available capacity of the reservoir will be about 435,000,000 gal., the flow line being 25 ft. above the surface of the present lake.

The area of the reservoir surface (56 acres) will equal nearly, the area of the old Silver Lake park (58 acres) and will be about four times that of the existing Silver Lake. The total area within the taking line will be 165 acres, of which 96 acres will be under Board of Water-Supply control. Nearly one-third of the 96 acres will, however, be available for future public use, so that the

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land that may be utilized for park purposes will exceed the area of the old park by about 36 acres.

SUBSURFACE INVESTIGATIONS—The preliminary, subsurface investigations disclosed (what had been generally observed before) a rock floor covered with glacial drift. The rock occurs from 5 to over 100 ft. below the surface of the overlying bouldery till, gradually merging with the latter in places where most altered, in the form of a tight greenish clay.

Studies of the results of the test pits and borings, together with consideration of ground-water conditions, led to the general conclusion that the reservoir basins would prove comparatively water-tight. Until additions to present knowledge of the physical conditions are made by excavations incidental to construction, it is thought that cutoffs under the dikes will be unnecessary except for the North dike. The extent of this cutoff, together with its character, is indicated in Fig. 3, and was fixed after a test pit, sunk on the line of the proposed cutoff, had demonstrated the impossibility of excavating the trench on any reasonable slopes without sheeting, except perhaps at the top. An attempt will be made to draw the sheeting from the upper portion of this cutoff trench but at lower elevation in the trench it will of necessity be left in place undisturbed.

The resistance measure at this place was adopted as a justifiable precaution, although it was held that, if omitted, the flow that could reasonably be expected would not endanger the stability of a properly constructed dike. The bottom of the basins, where necessary, may be lined with impervious earthy material, especially at the toe of the West dike, otherwise no lining is contemplated for the bottom.

In connection with these studies the two springs, one shown in the North basin, Logan's spring,* and the other to the westward, were watched, together with the rainfall. Results seemed to indicate that they were fed by ground-water flow in the North basin valley and were not connected with the Lake, as was commonly supposed. The location of swampland, upstream from the North dike site, with the relative locations of these springs, seemed to indicate a more pervious surface layer upstream than at the site of the dike.

PREPARING THE RESERVOIR SITE—The present lake will be drained through the excavation for the gate-chamber, through the North basin and the North dike site. Clearing and grubbing operations have progressed considerably, to date, at these points. It is intended to remove all top soil and organic material from the entire bottom of the reservoir. Top soil may be treated with agricultural lime, not exceeding 5 lb. to the sq. yd.

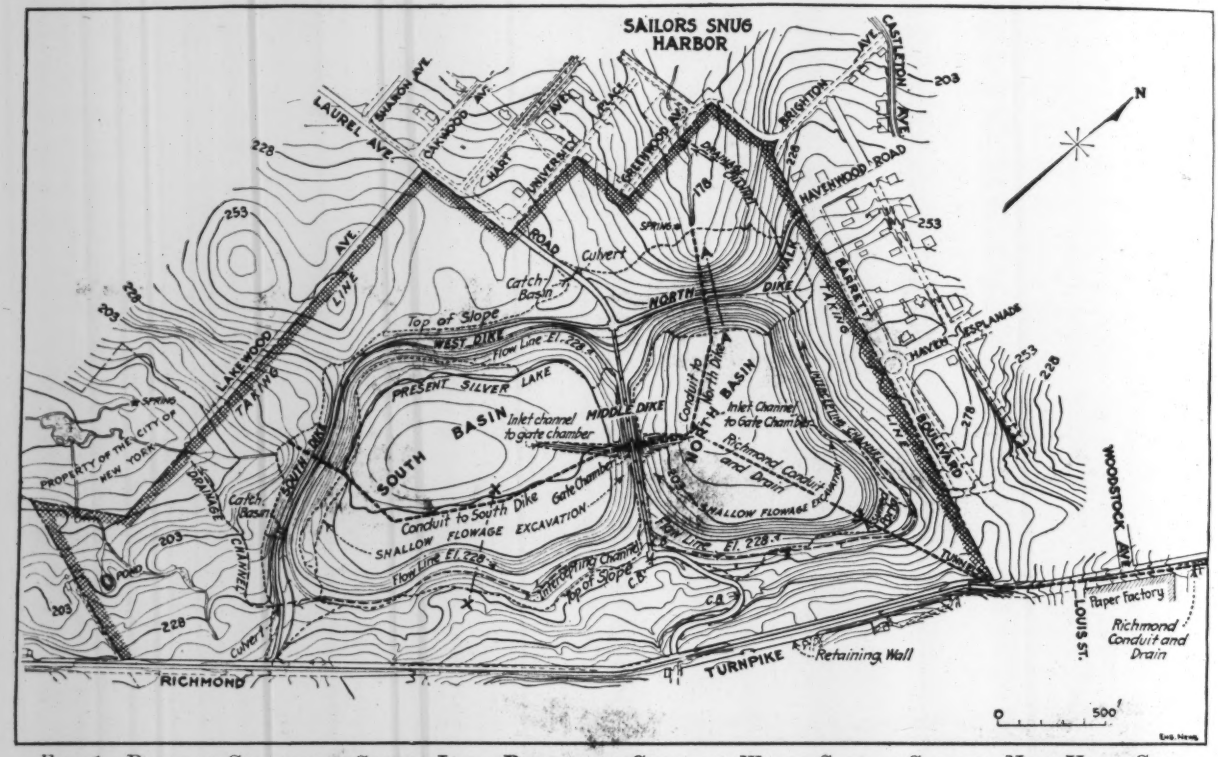

FIG. 1. PLAN OF COMPLETED SILVER LAKE RESERVOIR, CATSKILL WATER-SUPPLY SYSTEM, NEW YORK CITY

RESERVOIR APPURTENANCES—The dikes will be constructed of material excavated along the east side of the reservoir, designated as "shallow flowage excavation." No excavation along the west side will be permitted unless specially ordered, as it was decided best to leave that portion of the reservoir site undisturbed.

The specification's minimum requirements of shallow flowage excavation, as shown in Fig. 4, may be exceeded for the purpose of obtaining material; but the finished flow line must be left in acceptable shape. Wherever necessary, the slopes may be lined with broken stone as riprap.

The middle dike will be built on the natural ridge at

*Named in honor of the famous Indian Chief Logan, who was made immortal by Washington Irving's rendering of his speech to the white men in defense of his brethren. Logan's last home was in the vicinity of this spring, and in former days it was a popular picnic ground.

the north end of the present lake and will be lined with concrete. It will be given a more formal treatment than that of the other dikes to harmonize with the gate chamber.

A roadway will lead from Richmond Turnpike over the Middle dike, and passing between the two superstructures of the gate chamber, will connect with the roads over the other dikes and with the residential district to the westward.

The South, West and North dikes were studied with special attention to landscape treatment. Junctions with the contour of the hills were effected by sweeping curves that were continuations of the gentle sinuosities of the dikes.

CONCRETE CONDUITS—Three reinforced-concrete conduits in trench, 48 in. in diameter, will lead from the gate-chamber, one to the tunnel portal in the northeast corner of the reservoir (part of Richmond conduit), one to the downstream side of the North dike (North conduit), and one to the downstream side of the South dike (South conduit). The last two will be left available for future service connections.

The lengths of the Richmond, North and South conduits will approximate 2800, 1200 and 1800 ft., respectively, all of which, except about 1300 ft. in tunnel and the portion under the gate-chamber, inlet channels, will be of reinforced concrete. The reinforcement rings will consist of 1-in. square twisted steel bars, or equivalent, bent to 4 ft. 8 in. diameter, spaced 9 in. c. to c. Concrete cutoff collars will occur at intervals of about 30 ft. along the portions of the conduits under the dikes. Adequate metal water stops for construction and expansion joints in the conduits have been provided.

The tunnel section of the Richmond conduit will extend from the northeast corner of the reservoir to Richmond Turnpike near Woodstock Ave., where connection will be made with a 48-in. pipe to be laid under Contract 88 from the Narrows siphon (Richmond conduit extends from the gate-chamber to the Narrows siphon).

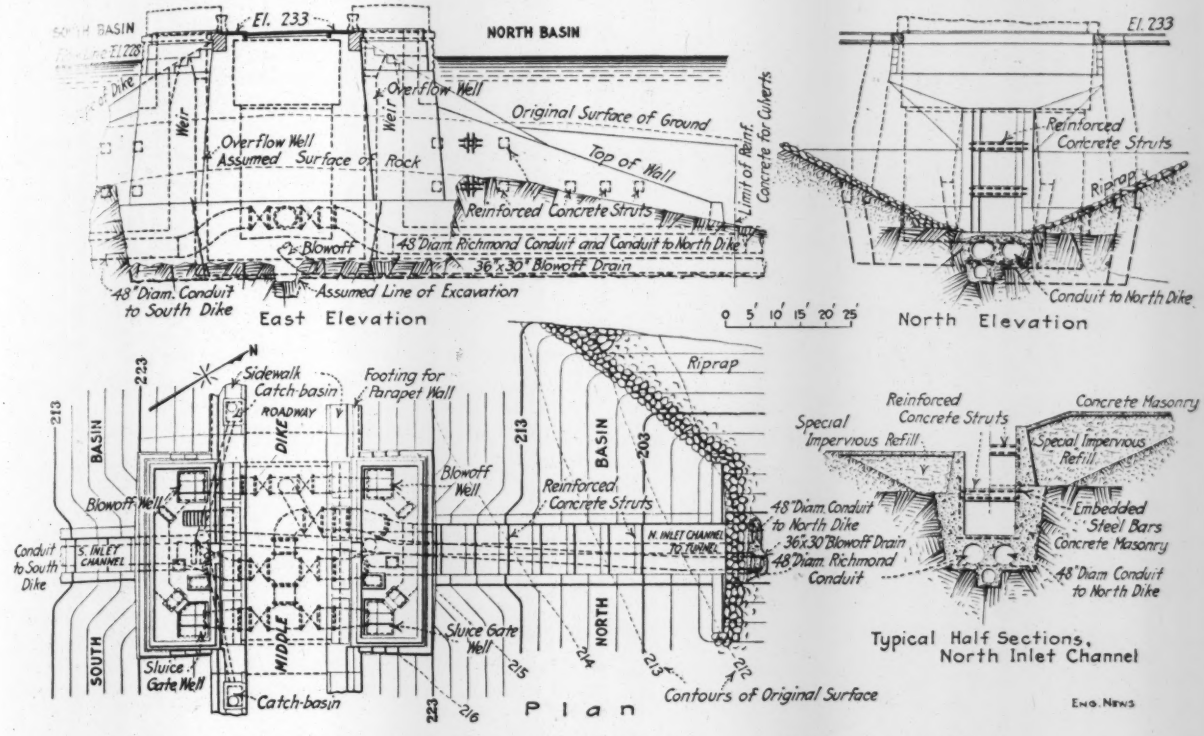

FIG. 2. GENERAL PLAN AND ELEVATION OF GATE-CHAMBER; SILVER LAKE RESERVOIR

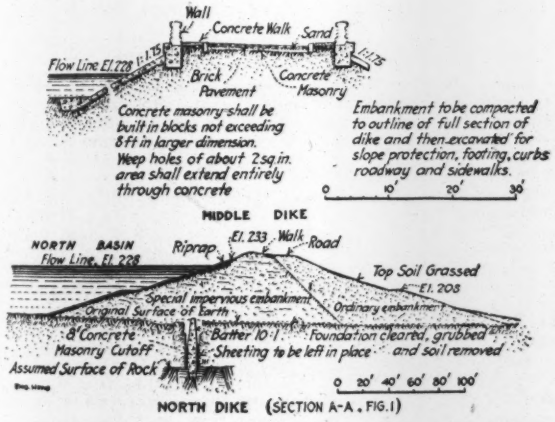
Wall
Concrete Walk
Sand
Flow Line El. 228
Brick Pavement
Concrete Masonry
Concrete masonry shall be built in blocks not exceeding 8 ft in larger dimension. Weep holes of about 2 sq in. area shall extend entirely through concrete
Embankment to be compacted to outline of full section of dike and then excavated for slope protection, footing, curbs roadway and sidewalks.
MIDDLE DIKE
NORTH BASIN
Flow Line, El. 228
Riprap
El. 233
Walk
Road
Top Soil Grassed
El. 208
Special impervious embankment
Ordinary embankment
Original Surface of Earth
8" Concrete Masonry Cutoff
Batter 10:1
Foundation cleared, grubbed and soil removed
Sheeting to be left in place
Assumed Surface of Rock
NORTH DIKE (SECTION A-A, FIG. 1)

FIG. 3. TYPICAL CROSS-SECTION OF EARTH DIKES; SILVER LAKE RESERVOIR

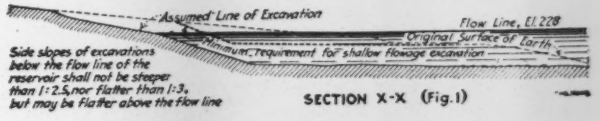
Assumed Line of Excavation
Flow Line, El. 228
Original Surface of Earth
Minimum Requirement for shallow Flowage excavation
Side slopes of excavations below the flow line of the reservoir shall not be steeper than 1:2.5, nor flatter than 1:3, but may be flatter above the flow line
SECTION X-X (Fig. 1)

FIG. 4. TYPICAL CROSS-SECTION OF SHALLOW FLOWAGE EXCAVATION; SILVER LAKE RESERVOIR

A blowoff drain is to be built with the Richmond conduit to and through the pressure tunnel excavation and thence will be connected with the existing egg-shaped sewer (2 ft. 2 in.x3 ft. 3 in.) in Richmond Turnpike. Through this blowoff the reservoir may be drained. Overflow from the basins, over their waste weirs in the upper part of the gate-chamber, will also discharge into this drain.

RICHMOND CONDUIT—The *A*, *B* and *C* lines of the Richmond conduit cross-section (Fig. 5) in tunnel have the following significance:

The *A* line is the line of minimum thickness of masonry lining, with reference to permanent encroachment of any unexcavated material, timbering, etc.

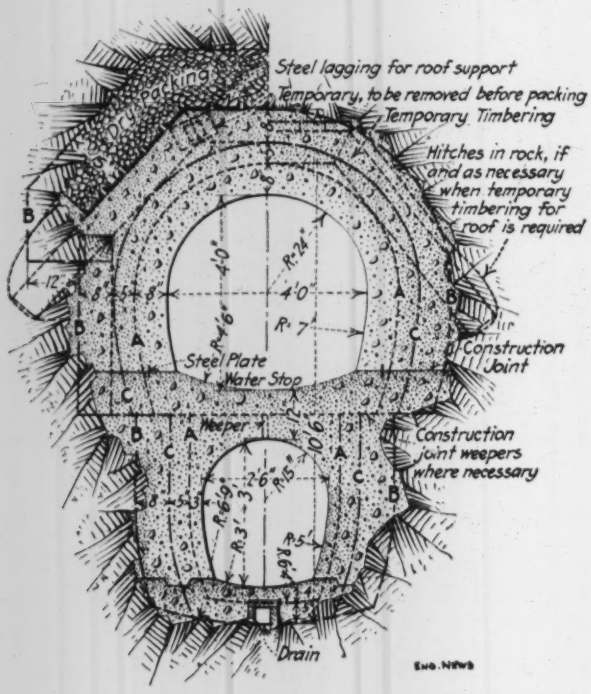
Steel lagging for roof support
Temporary, to be removed before packing
Temporary Timbering
Hitches in rock, if and as necessary when temporary timbering for roof is required
Dry Packing
Steel Plate Water Stop
Construction Joint
Weeper
Construction joint weepers where necessary
Drain
Eng. News

FIG. 5. CROSS-SECTION OF RICHMOND PRESSURE TUNNEL; SILVER LAKE RESERVOIR

The *B* line, in general, delimits the excavation to be paid for. In certain cases it may also serve as a payment line for masonry or dry packing.

The *C* line is the line of effective average thickness of masonry lining. Rock or other foreign materials will be permitted to remain within this line only under conditions governed by effective strength of the resulting lining.

The specifications, however, provide for additional trimming, modifications of thickness of lining, and for enlargement of permanently supported tunnel section, if necessary.

GATE-CHAMBER AND VALVES—The flow in the Richmond, North and South conduits will be controlled within the gate-chamber by 48-in. valves, directly below the roadway over the dike. These valves, together with the 36-in. blowoff valves, may be operated, ultimately, by hand or electrically.

The gate-chamber controls fully the flow to and from the reservoir, with the basins receiving or contributing either together or independently of each other. The flow between the basins may also be controlled.

The interior of the gate-chamber, beneath the roadway, will be divided by a removable, reinforced-concrete slab floor into an upper or operating chamber and a lower or valve chamber.

The operating chamber, access to which will be obtained by stairs from the superstructures on either side, will contain the gate stands, operating mechanism and float-gage scale. Drainage of the chamber (through a 10-in. valve and pipe) and blowoffs of the main conduits and wells through 6-in. valves, will connect with the blowoff drain mentioned above. The sluice-gates, screens and stop "shutters," the last named constructed entirely of steel, will be handled from the interior of the superstructures. The roof of the operating chamber, forming the subgrade of the roadway, will also be removable, so that at any future time, should necessity demand, any of the gates or castings below can be removed and replaced.

OPERATION OF RESERVOIR—The operation of the reservoir, when the three conduits shall have been connected with the Staten Island service pipes, may be likened to that of a standpipe. When ultimate adjustment is attained, its content, varying with the flow from the Narrows siphon and the consumption, may be regulated with a minimum of valve operation in the gate-chamber. It will be possible, if desired, for cleaning or other purposes, to cut the reservoir entirely out of service for a time, during which direct flow from the Narrows siphon into the service mains would result; or, in case occasion should arise to cut off this direct supply, the reservoir could serve during such suspension of flow from the Narrows.

PERSONNEL—The distribution of supply through the Island will be in charge of the Department of Water Supply, Gas and Electricity of the City of New York. The construction work is being carried on for the City of New York by the Board of Water Supply, J. Waldo Smith, Chief Engineer; Alfred D. Flinn, Department Engineer of Headquarters, where all designs are made; Walter E. Spear, City Aqueduct Department Engineer, under whom are John P. Hogan and James F. Murphy, respectively, Division and Section Engineers. The writer, ably assisted by Alfred W. Arenander, Assistant Engineer, designer, has charge of the designs and specifications under the direction of Fred F. Moore, Designing Engineer.

The Roosevelt Mine Drainage Tunnel, now completed, was built to drain the mines at Cripple Creek, Colo., and enable the mines to be sunk to greater depths, while eliminating the heavy cost of pumping. The tunnel is about four miles long, 10 ft. wide and 6 ft. high, with a ditch 3x6 ft. along one side of the floor. No lining was necessary, the tunnel being driven in very hard granite, which made drilling difficult, and made it impossible to break the ground to the bottom of the drill holes. The granite forms a great basin filled with fissured volcanic rock in which the mines are sunk and which is full of water. The original water level was about 1200 ft. above the level of the tunnel. The success of a tunnel in draining the El Paso mine in this district led to the cooperation of mine owners in driving the Roosevelt tunnel for the drainage of the entire district, this tunnel being 1500 to 2000 ft. beneath the surface. A drill hole from the bottom of the El Paso shaft with the tunnel served to drain that mine, and lateral drifts were run to tap different underground water courses or pockets. The present flow is from 7000 to 8000 gal. per min., and the water level in the volcanic rock is being lowered at the rate of about 100 ft. per year. A. C. Carlton, of Cripple Creek, was the contractor.

Present Practice in Design and Construction of Hydraulic Turbines*

By H. B. Taylor†

During the past ten years remarkable progress has been made toward bringing the turbine to a high state of perfection. (1) Theoretical investigation and experimental research have increased efficiencies about 10%. (2) Corrosion of runner vanes has been eliminated subsequent to demonstration that it is primarily the result of defective design. (3) The development of high-specific-speed runners, permitting higher rotational speeds, has retired the multi-runner turbines in favor of the vertical-shaft, single-runner type. (4) It is known that the make or type of governor has little or nothing to do with speed regulation, except as it must have sufficient power and proper adjustments to move the gates in a certain time and without hunting.

EFFICIENCY

Ten years ago it was a notable achievement to obtain a turbine efficiency of 82% in place. The maximum guarantees of the builders were from 78% to 80%, and were considered highly satisfactory. During the past two years, efficiencies of 89% to 92% have been common, while a maximum value of 93.7% has been secured. Today the builder must guarantee at least 87% to secure business. Improvements in wheel-casings, wicket gates, draft chests and draft tubes have increased efficiency as much as the more efficient runners.

Most of the important contracts are now awarded on a basis of merit. A great amount of work is done on a cost and percentage basis. The ability of the builder properly to construct the apparatus in accordance with his design is now taken into consideration in comparing competitive designs. A guarantee of high efficiency is no longer satisfactory unless it can be justified by reliable data from tests on similar apparatus, or in connection with experimental turbines tested by disinterested parties. The builder who demonstrates that his guarantees will probably be exceeded, is given preference over one who may have made the same guarantees but is unable to prove an equal reserve margin. Engineers of power companies frequently volunteer to share in the expense of experimental work which will aid them in selecting the best type of apparatus. In many contracts for waterwheels placed during the last few years the builders have been required to guarantee the efficiency on a bonus and penalty basis, the rate ranging anywhere from $1000 to $5000 per unit for each 1% efficiency above or below a certain figure.

The present attitude of the power companies toward builders has been the result of a better appreciation of the fact that success or failure depends primarily upon the performance of the turbines. The total investment, represented in water rights, franchises, dam, power house, turbines, generators, transformers, transmission lines, etc., may involve many millions of dollars. The amount paid for turbines is only a small proportion of the total investment—say from 2½ to 10%. With the success of the total development dependent upon proper performance of turbines and earning power of total investment in proportion to efficiency of turbines, the folly of chancing the installation of inferior apparatus is self-evident.

The most striking feature of recent designs is the absence of sudden turns and abrupt changes of section in all water passages from the turbine casing to the tailrace. Although the older designs were thought to be consistent with good results, they now appear exceedingly crude.

By means of the Pitot tube, it has been possible accurately to determine the conditions of flow in the turbine casing, through the guide vanes, between the vanes and the runner, and in the draft tube. It has been possible to compare actual conditions of flow in various parts of these with the calculations.

In the past five years the builders have made extensive tests at the Holyoke testing flume on small runners ranging from 12 to 36 in. in diameter—exact models of large runners which were contemplated. Various designs of wicket gates and draft tubes are used in connection with the testing of these models. The results have given the builders valuable data upon which to base the design of any new work calling for runners of like characteristics, and empirical constants by which they have modified their theoretical data.

The head corresponding to the velocity of discharge from the runner into the draft chest or tube may represent a considerable proportion of the total head on the turbine. With runners of high specific speed, this velocity head may be from 25% to 30% of the total. It is essential to design the draft tube carefully to convert this velocity into effective head. Improvement in draft tubes has been marked. It was thought at one time that the draft tube was simply a device to locate the turbine above tailwater level without losing the effective head between turbine and tailrace. Today, however, the draft tube is looked upon as an extremely important part of the turbine; in fact without efficient draft tubes, runners of high specific speeds would be impracticable.

Draft tubes have been built with constant diameter from runner to tailrace. Consequently, the velocity at the runner discharge existed also at the end of the draft tube, and the energy represented by this velocity was entirely lost to the turbine. In addition there was frictional loss from the high velocity throughout the entire length of the draft tube. By properly designing the tube so that the velocity is gradually reduced from a maximum at the runner to a minimum at the tailrace, the vacuum in the draft tube may be increased and, consequently, the effective head on the turbine.

Until the last two years most turbines for low and medium heads were of the old fashioned multi-runner type—two, four, six and more runners on a shaft grouped in pairs discharging into a common draft chest and tube. The energy of discharge velocity from the runners was practically lost to these turbines, owing to the impact, eddies and whirls in the draft chests and tubes as a result of the runners discharging against each other. The multi-runner unit, when now built, is an efficient machine. The principal improvements have been in allowing a greater distance between runners which discharge into a common draft chest, and in designing the chest so that water from each runner is carried into the draft tube to a point where the two streams are moving in parallel directions, before allowing them to converge. But even with the best multi-runner turbines, there is always present an appreciable loss due to the comparatively sudden turns which the water from runners must follow.

In many power developments carried out a number of years ago, even such efficiency as could be obtained from the turbines cannot be realized in the operation of the plant as a whole. Poor designs of the waterways leading to the turbine casing and receiving the discharge from the draft tube cause considerable losses outside of the turbine passages. In some instances, losses of head amounting sometimes to one or two feet at submerged arches, bridge piers or racks, have been overlooked.

CORROSION OF RUNNER VANES

It is now realized, especially by those who have been taught in the school of bitter experience, that mechanical reliability and stability of construction are of even more importance than efficiency. Among other sources of interruption to service, the deterioration of runner vanes has in the past been a frequent cause of trouble.

Corrosion, or pitting, of runner vanes, guide vanes and draft tubes is no longer a serious obstacle. Its cause is now pretty well understood and, by correct designing, can be eliminated. Turbine builders guarantee the lasting qualities of turbines for operation under any head up to 650 ft., provided the speed and power in each case are so chosen as to be consistent with favorable hydraulic conditions.

Corrosion, or pitting, must be distinguished from erosion—mechanical wear by foreign substances in the water. Erosion is entirely a mechanical action, while corrosion, or pitting, is the result of chemical action. Eroded parts are smooth and can be readily distinguished from the pit marks of corrosion.

It has been demonstrated that corrosion is primarily a question of design. It has been clearly shown in practice that, where sharp curves are resorted to, where contraction is not sufficient, or where there are pockets formed in the surface of the vanes, pitting inevitably develops. It has also been demonstrated that where air in large quantities is entrained in the water, corrosion seems to take place very rapidly if the design is not correct. While it is true that corrosion takes place more quickly under high than under low heads, some runners under as low as 25 to 30 ft. have been found to corrode rapidly. It is, therefore, essential that the runner be carefully designed, regardless of the head under which it is to operate, but extreme precaution must be taken in cases where the head is excessively high.

A corroded vane surface has an appearance resembling a sponge, the surface being extremely irregular and the pitted spots often opening holes entirely through the vane. Chemical analysis of the corroded surfaces has brought out the fact that the metal has been oxidized. In runners made of bronze or alloy, modifications in the composition have been detected in the corroded portions.

*Extracts from a paper before the Canadian Society of Civil Engineers, Jan. 15, 1914.

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The theory now generally accepted is that the water in passing over any pocket or depressed surface, or in failing to adhere to the surface of the vane, leaves spaces which are filled with high-velocity eddies under very low static pressure, at which oxygen is liberated in the nascent state and rapidly attacks the surface of the metal. An oxide coating is formed, the greater part of which is rapidly washed away by the water. Once the depth of this pocket is increased by corrosion, it is natural that the pitting should continue at an accelerated rate.

It is quite likely that electrolysis is present as a result of the oxidation of the metal, for it has been noticed with built-up runners, where plate-steel vanes have been used with iron or bronze bands and hubs, that corrosion seems to develop more rapidly than with runners of uniform metal. Foreign engineers have given instances where the metal eaten out at one section has apparently been redeposited at another, evidently the result of electrolysis. If electrolysis does exist, it is a secondary action and may be eliminated by first preventing corrosion.

The fact that a runner develops high efficiency under test is not a guarantee that corrosion will not take place. Small defects in the curved surfaces of the runner vanes will be very quickly brought out by the fact that they corrode. These defects in the flow through the runner may be too small to be detected in an efficiency test. In general, however, high efficiency and freedom from corrosion are complementary qualities.

While corrosion is primarily caused by defective design, some metals are more susceptible to its action than others. For example, bronze resists corrosion better than does either cast steel or cast iron; but if the runner is so designed as to permit corrosion to take place, it matters little what metal is used. Cast iron today is used as a material for runners to a much greater extent than heretofore and, as a result of careful designing, it has been successfully employed under conditions which, until recently, were thought to be impossible. Cast steel is thought to be the most undesirable metal from considerations of corrosion, on account of the unavoidable roughness of the surface.

Runners regulated by means of cylinder gates are particularly subject to corrosion, owing to the eddies produced behind the cylinder gates at fractional gate openings. Corrosion will often develop in a runner if the turbine is operated continuously at low gate openings. The falling-off of the efficiency of a turbine at low gates is an indication that the hydraulic conditions within the runner are greatly disturbed, and this disturbance tends to promote corrosion. High-specific-speed runners, if applied to high heads, are also subject to corrosion, owing to the high velocities to be dealt with and the difficulty in making the water follow the radical curves characteristic of the vanes of these runners.

Corrosion has often been greatly accelerated because of poor draft-tube conditions. It is evident that should the total draft head, or the sum of the static draft head and the velocity head at the runner discharge, exceed the height of the water barometer, the continuity of flow of the water on leaving the runner is destroyed. When the absolute static pressure in the draft tube falls to a value equal to the vapor tension corresponding to the temperature of the water, the water will vaporize and the draft tube will not be filled with a solid column tailrace to runner. Therefore, the placing of a turbine simply within 34 ft. from the elevation of tailwater is no indication of proper elevation; for it is also necessary to allow at least three or four feet margin between the total draft head and a perfect vacuum to prevent the breaking of the column of water in the draft tube due to inertia effects of sudden changes of load.

It must also be borne in mind, and this is a point which has been frequently overlooked, that in figuring the margin between the maximum vacuum and the total draft head, the maximum vacuum should be considered for the particular elevation above sea level at which the turbine is to be installed.

In respect to erosion, however, although the best metals are used in resisting its action and high factors of safety are adopted in all parts of the machinery which may be subjected to it, yet it must necessarily be expected wherever the quality of the water is such as to produce it.

THE HIGH-CAPACITY RUNNER, AND THE VERTICAL, SINGLE-RUNNER TURBINE

Until two years ago, most low-head turbines were of multi-runner type—either vertical-shaft or horizontal-shaft. More than one runner on the shaft, mechanically, is not desirable, but permits high rotational speeds and, therefore, economic sizes of generators.

During the past two years, however, the general adoption of the single-runner, vertical-shaft turbine for low and medium heads, has been witnessed. This has been possible by recent development of high-capacity runners. [illegible]s. for a given head and speed it is now possible to se[illegible] from a runner a greater output than was possible two or [illegible]ce years ago; or, conversely, for a given head and capacit[illegible] is possible to operate the more recently designed runner [illegible] a much higher rotational speed. This increase in capacit[illegible] has been secured without a sacrifice of maximum efficienc[illegible]nd with only a small sacrifice in efficiency at fractional l[illegible]ds.

In referring to the capacity of a runner, there is a certain relation between head, speed and power output which is best expressed by a theoretical characteristic known as "specific speed" (N_s) first introduced by German engineers. It gives us a means of comparing the relation between the conditions of speed, head and power of a runner in one installation with the same conditions relative to a runner in a totally different installation. This comparison is made after the conditions governing the design of both runners have been reduced to a common base, viz., specific speed.

The specific speed of a runner may be defined as the speed at which any runner would operate if it were reduced to such a size that it would develop one horsepower when operating under a head of unity. The numerical value of the specific speed of any runner, expressed in the metric system, may be found by first calculating the speed and power output of the runner under consideration for one meter head, and then mathematically reducing the runner in size until it will deliver one horsepower. The speed of this reduced runner, when operating at its point of maximum efficiency is its rated specific speed, and this speed is:

$$N_s = \text{r.p.m.} \times \frac{\sqrt{\text{hp.}}}{h^{\frac{5}{4}}} \text{ (metric system)}$$

$$N_s = 4.45 \times \text{r.p.m.} \frac{\sqrt{\text{hp.}}}{h^{\frac{5}{4}}} \text{ (ft.-lb. system)}$$

N_s remains in the metric system. The specific speed as calculated from this latter formula is the one generally used. In figuring the specific speed of any turbine having more than one runner, the horsepower used in the formula, of course, is the output of each runner.

An examination of the formula will show that for a given r.p.m. and head, the hp. output is proportional to the square of the specific speed; also that for a given head and hp., the r.p.m. of a turbine is proportional to the specific speed. Five years ago a specific speed of 275 was considered to be quite high, while today a specific speed of 400 is secured together with as high a maximum efficiency as was previously secured with a specific speed of 275. Thus, today it is possible with very high efficiency to secure, for a given condition of head and power and with the same maximum efficiency, a speed in the neighborhood of 50% greater than was possible five years ago; or, for a given head and speed, an increase of approximately 100% in the horsepower can be obtained.

With the highest specific speed wihch could be secured five years ago, the resulting r.p.m. for a vertical-shaft, single-runner turbine for low heads was usually such as to make the cost of both the turbine and generator prohibitive. During the last two years, however, with runners of increased specific speed, a much higher rotational speed can be secured for the same head and power, so that the turbine and generator designs have become thoroughly practical and economical. Although it is true that the rotational speed secured in such a turbine is low when compared with the speed secured with turbines of the same specific speed and having two or more runners, there are many mechanical advantages involved in the use of the single-runner vertical turbine for low heads which more than overbalance the increased cost of the generator.

The following are among the recent prominent low-head plants for which the single-runner vertical-shaft turbines have been adopted.

Appalachian Power Co., New River, Va.: Development No. 2, four 6000-hp. units, head 49 ft., speed 116 r.p.m.; development No. 4, three 3500-hp. units, 34 ft., 97 r.p.m. These turbines hold the highest record of efficiency ever obtained, namely 93.7%.

Mississippi River Power Co., Keokuk, Iowa: Fifteen 10,000-hp. units (ultimate installation thirty units), 32 ft., 57.7 r.p.m.

Georgia-Carolina Power Co., Stevens Creek, Ga.: Five 3125-hp. units (ultimate installation, ten units), 27 ft., 75 r.p.m.

Alabama Power Co., Lock 12, Coosa River, Ala.: Four 17,500-hp. units (ultimate installation, six units), 68 ft. 100 r.p.m.

Cedar Rapids Manufacturing & Power Co., St. Lawrence River, Canada: Twelve 10,800-hp. units (ultimate installation, 18 units), 30 ft., 55.6 r.p.m. These will be the largest turbines in the world in point of dimensions, and will each weigh approximately 1,250,000 lb.

Laurentide Co., Limited, Grand Mere, P. Q., Canada: Present installation, six 20,000-hp. units (ultimate installation, ten units), 76 ft., 120 r.p.m. These will be the highest powered single-runner vertical turbines in the world to date.

Northern Ontario Light & Power Co., Cobalt, Canada: Two 1500-hp. units, 30 ft., 150 r.p.m.

Turners Falls Co., Turners Falls, Mass. Three 9700-hp. units, 54 ft., 97.3 r.p.m.

Among the principal advantages of the single-runner unit are the following:

(1) Only one gate mechanism is required, and this is located above the head cover of the turbine and is accessible at all times for inspection while the unit is in operation. The only parts of the turbine that are submerged are the runner and the guide vanes. Repairs can be made to the gate operating mechanism without dismantling the turbine.

(2) Owing to the fact that only one gate operating mechanism is used, involving a small number of parts, the chance for breakage is reduced to a minimum, and lost motion and deflection in the governor engine connections are avoided.

(3) It is possible to secure an ideal draft tube of long flaring section, without an obstruction or sudden turn. Therefore it is possible to use runners of the very highest specific speed, as the draft tube can be designed to convert the velocity at the discharge from the runner buckets into effective head with small degree of loss.

(4) It is possible to mold in the concrete a spiral turbine casing similar in design to the cast-iron spiral casings used in connection with high-head turbines. It would be impracticable to prepare spiral casings for vertical or horizontal turbines having two or more runners, for obvious reasons.

(5) It is very often posible to locate the runner and gate mechanism above high tailwater level, so that after closing down the head gates and draining the wheelpit, an attendant may examine all parts of the turbine without first having to pump out the wheel-chamber.

The advantages of the single-runner vertical wheel have made it most desirable for low-head installations and also for many high-head developments; undoubtedly this type will be very generally adopted in the future.

SPEED REGULATION

Speed regulation is of great importance where turbines are employed for driving alternators. Regulation is obtained by a governor, driven from the turbine shaft, consisting primarily of a governor head containing flyballs controlled by springs and connected through a pilot valve to the main governor valve. At normal speed the flyballs hold the governor valve in its mid-position, but for any change in speed the flyballs move the valve, admitting pressure through a suitable number of relay valves to an operating cylinder so that the turbine gates are adjusted to suit the new load and to obtain the normal speed.

Some of the chief speed-regulation requirements are:

(1) Sensitiveness—quick response to sudden and slight changes of speed.

(2) Steadiness—freedom from unnecessary gate movements or movements occasioned by conditions other than changes of load. Continual motion and vibration of the turbine gate mechanism produced by unstable governors is a source of wear and rapid deterioration which in turn accentuates the instability. In older types of governors this tendency was usually overcome by the use of a dashpot to damp such motions, but the use of a dashpot for this purpose renders the governor sluggish and impairs its action.

(3) Ample power of governor. For large units, a large amount of power is required to actuate the turbine gates. With a large unit, either a considerable number of intermediate valves between the pilot valve and the main valve must be used, or else the governor head itself must be given a considerable amount of power. The same result could perhaps be accomplished by the use of high pressures in the governor system, but these have proved very unsatisfactory. Increase of power by a series of valves is limited by the speed of action required. The best solution seems to be in the use of flyballs having a weight and power corresponding in order of magnitude to the turbine which they must control. Such increase in power in the flyballs involves no sacrifice in sensitiveness, since the governor head is mechanically connected to the turbine shaft and is forced to respond immediately to any change in speed of the unit. The sensitiveness will, in fact, be increased by the use of heavy flyballs, since the retarding effect of friction can be made relatively less.

(4) Reliability. Delicate and complicated mechanisms should be avoided. Governors in important stations should be as simple and rugged as possible. The effect of accidental conditions on a large and heavy governor, grit in the governor fluid or sticking of the governor parts, will be comparatively slight.

(5) Single-pressure system. Separate pumping equipment for each unit in a station has been abandoned in favor of a single pumping system supplying the entire station with greatly reduced cost of attendance and greater continuity of service. The open system of governing is now being used in which oil or water for the governors is pumped from an open tank and no pressures less than atmospheric are used at any point in the system. This change avoids troubles caused by air collecting in the pipes or pumps or the breakdown of oil under high vacuum.

(6) Good hand control. Originally the hand control of a turbine was through trains of gears. The time required to close the gates of a large turbine by such means is prohibitive. This gear was gradually replaced by a governor hand wheel controlling the turbine gates by oil pressure through the governor main valve. However, should the governor valves be dismantled for repairs the turbine must be shut down, and it is poor engineering to dispense with the services of the turbine for the sake of a governor valve. The best method of hand control now adopted for large units, seems to be in a separate device to admit oil from the central pumping system directly to the operating engine.

(7) Few simple operations. Compensating devices are required to restore the governor valves after required gate movement and also to restore the speed of the turbine to required value after the water column in penstock, turbine casing and draft tube has had time to be accelerated or retarded to its new value. The governor should also have adjustments, so that the change in speed from full load to no-load conditions may be fixed to suit the parallel operation of alternators, also to adjust the time of action of the governor to suit the length of and velocities in the water passages, and an attachment for changing the normal speed of the turbine. Modern governors are also fitted with motors by means of which the speed of the turbine can be adjusted from a distant point, such as the switchboard, this device being used in synchronizing the unit.

The above points cover all the features which can be controlled in the design of the governor itself.

A perfect governor will be unable to produce a speed regulation better than that permitted by the length of and velocities in the penstock and draft tube, the length of the water column in the turbine casing and the flywheel effect of the rotating masses. These factors are controlled by the design of the power development as a whole, so that the actual speed regulation obtained is affected only to a limited extent by the construction of the governor itself.

In a majority of the recent large installation the governors have been designed and constructed by the turbine builders suited to the exact conditions of each turbine and avoiding division of responsibility. The better appreciation of the factors entering into governor problems has resulted in greatly improved speed regulation which, when taken in connection with valuable improvements in the mechanical design of the governor, has removed this important auxiliary from the class of necessary evils and placed it in that of reliable machinery.

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Public Land Surveys by the U. S. General Land Office—As probably nearly all our readers know, the public lands of the United States are no longer surveyed by contract, which was the practice for many years; and nearly every surveyor west of the Mississippi River knows from experience that much of this contract surveying was unconscientiously done. The public-land survey work is now done by salaried employees of the General Land Office. The recent report of the Commission of the Land Office states that in point of character of work, area surveyed and cost, the past season's work in surveying shows better results than at any time heretofore in the history of the General Land Office.

About 250,000 acres were surveyed at a cost of 3.8c. per acre for fieldwork. Most of this newly surveyed area lies west of the 105th meridian of west longitude and includes Alaska; but extensive surveys and resurveys have also been made in Nebraska, South Dakota and Arkansas, while fragmentary and investigation surveys are now being executed in Florida and Louisiana. In addition to this immense work which identifies for disposal approximately 75,000 quarter-sections, the General Land Office has made numerous investigation and examination surveys, including an investigation of a portion of the Oregon-California boundary line, townsite surveys, small holding claims, Spanish land grants, abandoned military reservations, surveys of reservations for the Navy Department, island surveys, a survey of the boundaries of the Sequoia National Park and resurveys of thousands of state land selections, school sections and private land claims.

Improvements on the Louisville and Nashville R. R.

SYNOPSIS—The improvement of existing lines of railway represents a large and increasing proportion of railway work in this country. This is due in part to relatively light original construction in days when traffic was light, in part to the development of small local lines into parts of main-line routes, and in part also to the enormous growth of traffic and the vastly increased weight of equipment and of trains. The accompanying article describes work of this kind on a 200-mile stretch of a large railway system. It is of particular interest in that part of the work was done by contract and part by company forces.

The Louisville & Nashville R.R. Co., with a system aggregating upwards of 4700 miles of road, is carrying out extensive improvements on different parts of its lines in order to increase traffic capacity, and to give more favorable and economical operating conditions on divisions handling heavy traffic. The present article deals with some of the important improvement works along the main line between Nashville and Birmingham.

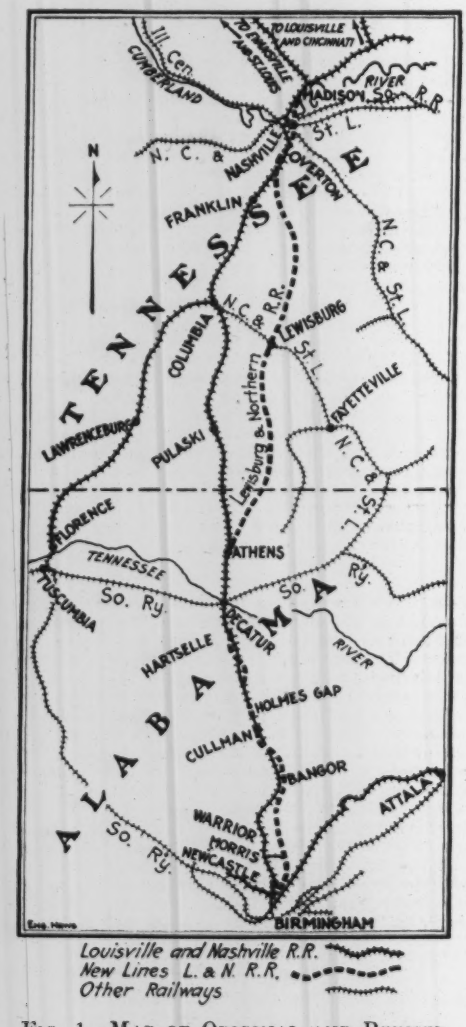


FIG. 1. MAP OF ORIGINAL AND REVISED LINE OF THE LOUISVILLE & NASHVILLE R.R., BETWEEN NASHVILLE, TENN., AND BIRMINGHAM, ALA.

Under the system of organization on this road all bridge and masonry plans are prepared under the direction of W. H. Courtenay, Chief Engineer. Robert Montfort is Consulting Engineer. The construction work, including the awarding of contracts, is in charge of a separate department which is under the direction of John H. Peyton, Chief Engineer of Construction, who also has charge of all construction work done by company forces. The tracklaying on all new work is done by company forces, and is in charge of W. E. Smith, Superintendent of Construction. The division engineers of the works described below are as follows:

Nashville to Lewisburg, Tenn.	W. S. Morton, Jr.
Lewisburg to Athens, Ala.	G. W. Feagin
Athens to Decatur, Ala.	C. H. Crawford
Decatur to Birmingham	T. Q. Harrison
Cincinnati to Winchester	H. G. Laird
Winchester to Jackson	E. D. Sloan
Radnor and Irvine yards	E. L. Trowbridge

The Nashville-Birmingham line is one of the heavy-traffic lines of the Louisville & Nashville R.R. System, divided into two divisions aggregating about 208 mi. in length, with ruling grades of 1.40% between Nashville and Decatur, and 1.25% between Decatur and Birmingham. In view of the increasing traffic it became necessary to improve and increase the facilities, reducing grades and curvature and providing additional tracks. The map, Fig. 1, shows the position and extent of the improvements.

The improved line will have maximum grades of 0.4% between Nashville and Decatur, and 0.5% between Decatur and Birmingham, except that there will be a short grade of 0.9% on the former and 1.25% on the latter. The maximum grades are the same in both directions. The short heavy grades are both against southbound traffic, and the standard 3019-ton slow-freight trains (drawn by engines having a tractive power of 45,000 lb.) will be assisted at these points by pusher engines. On the new work the curves are mainly 1° to 3°, with a maximum of 4°, while the old line had numerous curves of 6°. However, some curves of 5 to 6° are required on the 1.25% pusher grade. The grades are compensated for curvature at the rate of 0.035% per degree.

General Description

The improvement work begins near Madison (8.5 miles north of Nashville), with grade reduction of the present double-track line for about 2.2 miles, followed by a new double-track cutoff passing around the city and crossing the Cumberland River by a long and high steel bridge. This cutoff enables through traffic to avoid the city, thus relieving the local facilities. It connects with the old line again at Overton (6.7 mi. south of Nashville). Just north of this connection, extensive yards and division terminal facilities will be established, to be known as the Radnor yard. The old line is then improved and double-tracked to Brentwood, about 4 miles.

From this point an entirely new line is being built under the name of the Lewisburg & Northern R.R., joining the old line again at Athens. This is single-track, but has provision for a future second track. The construction of this independent line was considered preferable to double-tracking and improving the old line, as a more favorable gradient was obtained with less costly work and a new territory was opened up and made tributary to the L. & N. R.R. System.

considerable reduction of grade through this town. Instead of traversing the town at the ground level, there will be a long cut over 20 ft. deep, and five grade-crossings will be replaced by reinforced-concrete bridges for the streets. This cutoff extends to Garden City, and the old line is then improved as far as Bangor, whence another cutoff of about 25 mi. extends to beyond Newcastle. Beyond this again is a short relocation which eliminates a swing in the line and a sag in the grade.

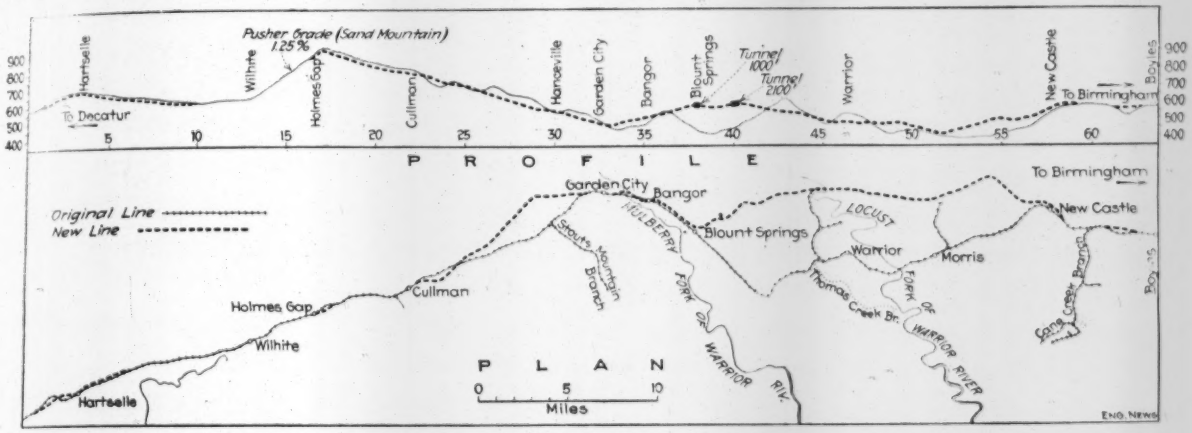


FIG. 2. PLAN AND PROFILE OF REVISION BETWEEN DECATUR, TENN., AND BIRMINGHAM, ALA.; LOUISVILLE & NASHVILLE R.R.

The location is approximately parallel with and 10 to 20 miles east of the old line. The distance is 95 mi., with the sharpest curves of 3° and maximum grades of 0.4%, except for the 0.9% pusher grade extending for six miles south from the Elk River. This is compared with 100 miles distance, 4° curves and 1.4% grades on the old line between the same points. The latter will be improved to some extent, but no great changes will be made. It will continue to carry most of the passenger traffic, with its local freight traffic, the new line being intended specially for the through freight.

Between Athens and Decatur, the work is revision and double-tracking of the old line, with a short cutoff north of Decatur which will reduce the length of trackage over the Southern Ry., by which the L. & N. R.R. enters Decatur. At Hartselle, there is another revision, but in the rough country beyond this (ascending Sand Mountain) it was found impracticable to change the location so as to secure a much lower elevation for the summit at Holmes Gap. Consequently the five-mile pusher grade of 1.25% was retained, though some changes were made in eliminating reverse curves, compensating grades for curvature and making a more regular profile. One of the side-hill cuts here is 120 ft. deep on the center line. Fig. 2 shows the revision between Holmes Gap and Blount Springs.

In approaching this grade beyond Wilhite, the subgrade is lowered along the bed of Flint Creek, which necessitated cutting a new channel in solid rock. This diversion channel is about 400 ft. long and 10 ft. wide, with a depth of 8 ft., its bed being about 6 ft. below the new subgrade. Beyond the summit, there is a long descending grade of 0.4% extending to the Warrior River (Mulberry Fork) near Garden City.

At Cullman (33 mi. from Decatur), there begins another relocation of about 12 mi. in length, with a

This is the last piece of improvement, and brings the line to Boyles, three miles from Birmingham.

Two important features of the improvement of this line are (1) the elimination and avoidance of highway crossings wherever possible, and (2) the reduction of bridge openings by the use of embankments with culverts or arches (several structures on the old line being filled).

The track on the new portions of the line will be laid with 90-lb. rails of the A. R. A. section (type B), car-

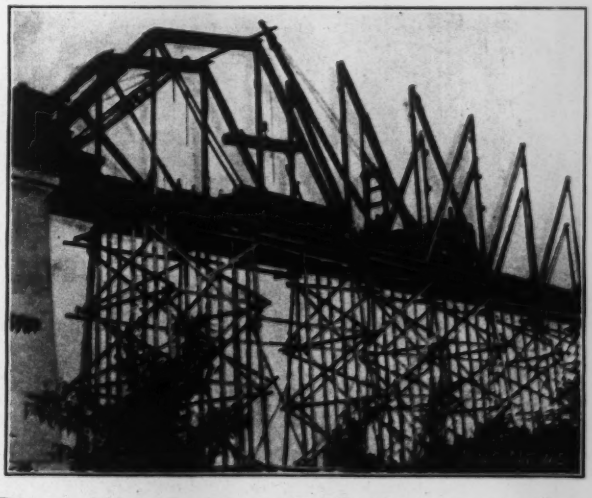


FIG. 3. ERECTION OF THE 300-FT. SPAN OF THE CUMBERLAND RIVER BRIDGE

ried on hardwood ties in slag and broken limestone ballast, and having steel tie-plates for all ties on curves.

BRIDGES

There are very few steel bridges on the new cutoff

lines, the policy being to use solid embankments, with pipe and concrete box culverts and concrete arches for such openings as may be necessary.

The longest and most important bridge is that crossing the Cumberland River on the Nashville cutoff. This has a total length of over half a mile, with the track at a height of 120 ft. above the water. The bridge proper has a through truss channel span of 300 ft., three similar spans of 200 ft. and three deck-truss spans of 125 ft., with steel viaduct approaches. The viaduct towers and spans were erected by two derrick cars. The truss spans were erected on falsework by means of a derrick car and a locomotive crane, the heaviest pieces handled weighing about 50,000 lb. The 300-ft. span is shown under erection in Fig. 3. The Foster-Creighton-Gould

and 5500 lb. per lin.ft. Near Athens there is a track trestle 300 ft. long, having creosoted pile ballasted deck.

Concrete Highway Bridges

The reinforced-concrete bridges carrying stre the new line at Cullman, Ala., as noted above, interesting design and are shown in Figs. 4 and 5. are of girder, beam and slab construction, havi main girders and seven beams or cross-girders, al ing a roadway slab, while cantilever extensions cross-girders carry the sidewalks and a light concre apet wall. The cross-girders occur at the columns the middle of each span. The three latter girde suspended beams) are anchored to the main girde

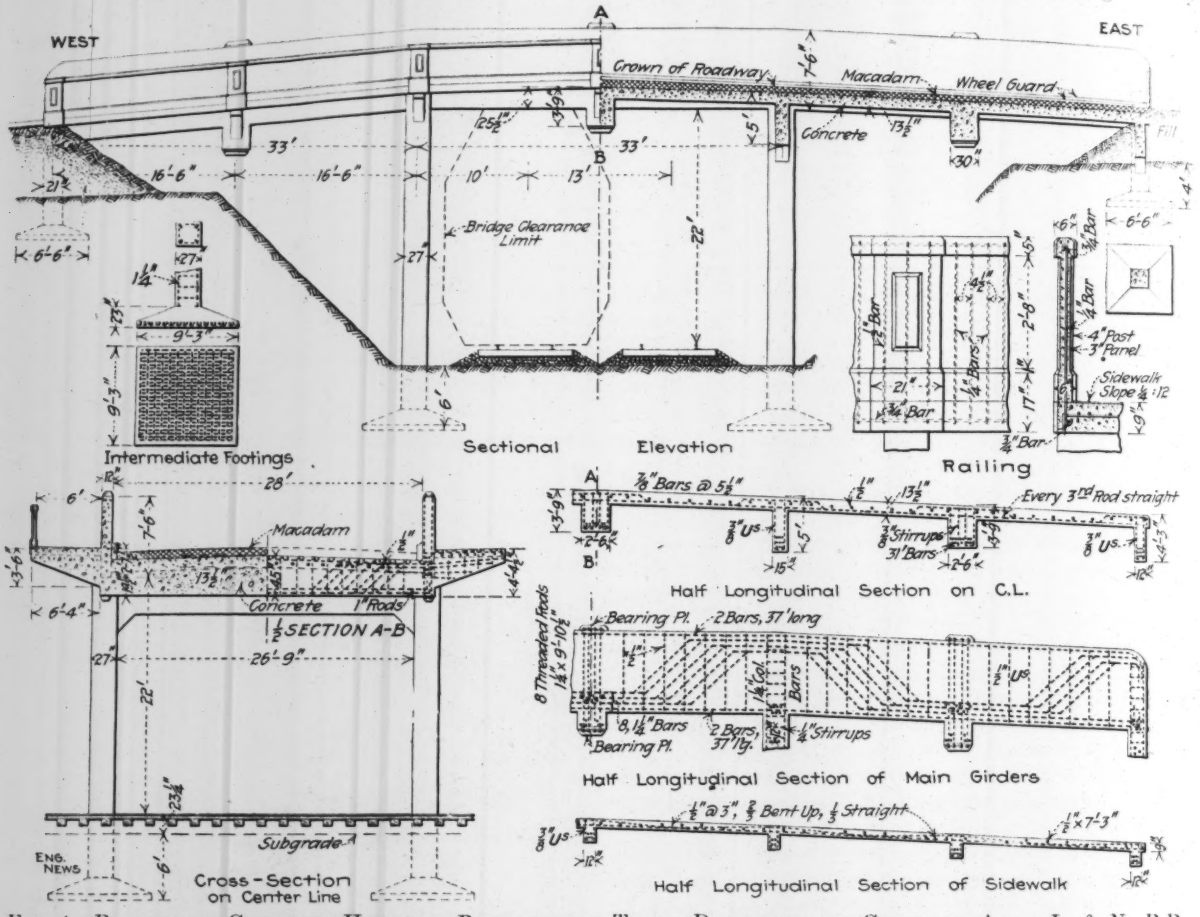


FIG. 4. REINFORCED-CONCRETE HIGHWAY BRIDGES OVER TRACK DEPRESSION AT CULLMAN, ALA.; L. & N. R.R.

Co., of Nashville, had the contract for substructure and erection, the steel work being manufactured by the American Bridge Co. This bridge was described in our issue of May 22, 1913.

A steel viaduct crosses the Mulberry Fork of the Warrior River near Garden City, Tenn. This is about 650 ft. long, having plate-girder spans of 35 and 70 ft. on steel towers and three deck-truss spans of 120 and 150 ft. on concrete piers. The Locust Fork of the same river is crossed by a similar structure about 900 ft. long, but having only one truss span, which is 200 ft. long. The steel bridges are designed for a live-load consisting of two 177½-ton 2-8-0 locomotives, plus one 88-ton tender

hangers composed of 1¼-in. twisted steel bars, with threaded ends fitted to bearing plates and having hexagon nuts (Fig. 5). There are concrete wheel-guards inside the girders, and the ends of the girders are protected by steel channels anchored to the concrete by bolts.

In construction, the bottom bearing plates of the hangers are set accurately before any beam concrete is placed. The top plates are first set with their ribs upward and above the nuts, to serve as templates spacing the bolts until the beam is completed beneath. These plates are then set in correct position and driven into place with light hammers, the nuts being kept tight. After the concrete has set and before the forms are removed, all nuts

(top and bottom) are tightened. The nuts and bolt ends are given two coats of red-lead and oil, and covered with a morta[illegible] protection which is troweled smooth.

The concrete is a 1:2:4 mixture, reinforced with twisted square bars. Plain concrete, however, is used for the wh[illegible] guards. The roadway slab is 13½ in. thick, floated to a smooth surface and covered with 6 in. of macadam paving. The sidewalk slabs are 6 in. thick, with the top ½ in. composed of a 1:2 sidewalk finish.

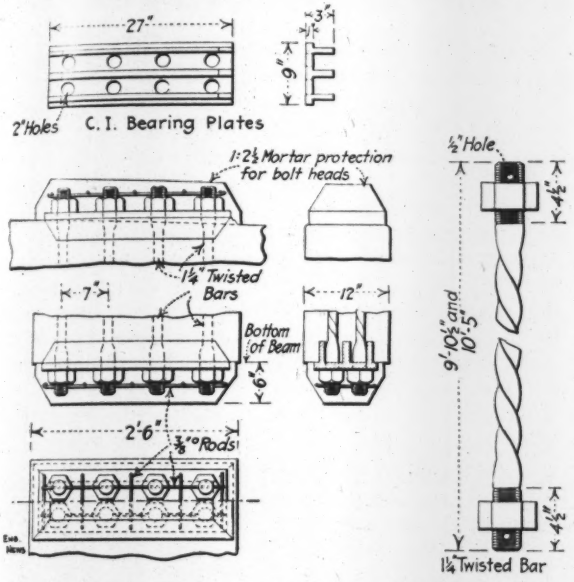


FIG. 5. STEEL HANGERS FOR CROSS-GIRDERS IN REINFORCED-CONCRETE BRIDGE

These bridges are designed to carry a live-load of 100 lb. per sq.ft. of roadway and footway surface; or a 35,000-lb. road roller on the roadway and 100 lb. per sq.ft. on the sidewalks.

There are four new tunnels. Two of these are on the new single-track line between Brentwood and Athens, but are being built for double-track. The other two are on the new low-grade double-track line between Decatur and Birmingham.

The two former tunnels are 1400 and 450 ft. long, the shorter one being on the 0.9% pusher grade. They are both being driven by the top-heading system. They are of the company's standard section for double-track roadway, giving 22 ft. headway above rail level of each track, and having a 24-in. concrete lining.

The two double-track tunnels on the cutoff line south of Bangor, are about 2½ miles apart. They are of the standard section, shown in Fig. 6, which also shows the timbering for roof only and for roof and side.

Both of these tunnels are on one contract section, and being so close together the contractor decided to supply compressed air to both from a single air-compressing plant installed on the old line, so that machinery and coal could be delivered without trouble. This plant was at Blount Springs, and the air pipes extended a distance of over three miles to the tunnels, where it was used to operate drills, hoists, shovels, concrete mixers and electric generators.

The first (or Blount Mountain) tunnel is 1000 ft. long. It is mainly in solid limestone, and required no timbering during construction, while it is expected that only short sections of the ends will require to be lined with concrete. A bottom heading was first driven through, the full width of the tunnel section and about 8 ft. high. For increasing the height to the full tunnel section, work was begun at the south portal, inclined drill holes being driven up into the roof. The muck pile was high enough for men to stand on it and dress the roof to shape, while at the toe of the pile an air-operated shovel loaded the rock into narrow-gage dump cars hauled by coke-burning locomotives.

The Hayden Mountain tunnel, about 2150 ft. long, is in less favorable ground, and as the material varies it required timbering throughout. From each portal was started a top heading 7 ft. high and 16 ft. wide, with its floor at the level of the springing. This was enlarged to the full roof section, heavy timber arch ribs being required for the whole length, and on account of particularly bad ground at the north end a large amount of heavy temporary timbering was required. The removal of the bench was the third stage of the work.

YARDS AND ENGINE TERMINALS

Freight yards will be provided at Radnor, north of Overton (for the Nashville terminal), at Oakworth (for Decatur), and at Boyles (for the Birmingham terminal). The yard at Radnor will be arranged for gravity switching for the classification work. The work at the two last-named places will be mainly extensions and rearrangement of tracks.

The Radnor yard will be an entirely new yard for handling southbound traffic converging from northern divisions which meet at Nashville, and for northbound traffic diverging to these divisions. There will be two sets

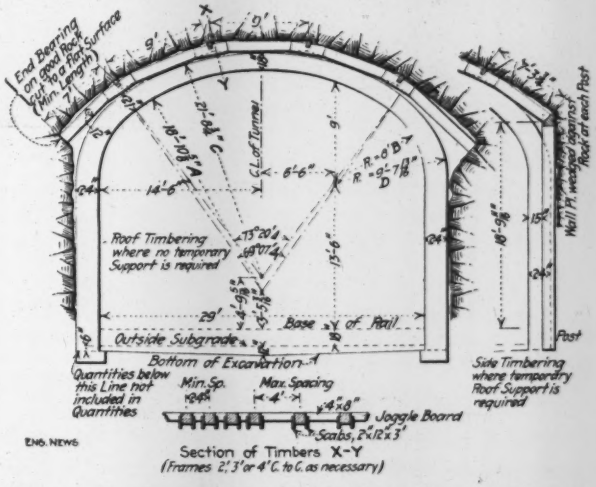


FIG. 6. STANDARD CROSS-SECTION OF DOUBLE-TRACK TUNNEL; L. & N. R.R.

of classification tracks, each with its switching hump, one for each direction of traffic. The yard will have about 60 mi. of track and a capacity for a total of 4500 cars, but the first construction will provide for about 3000 cars. Here also there will be an extensive engine terminal, with a 30-stall roundhouse, a 90-ft. turntable, a coaling station of 100 tons storage capacity, a car-repair shed, storehouse, office building, employees locker and rest house, etc.

At points on the Nashville-Birmingham line where sidings are provided for train use, these are made long enough for 80-car trains.

Construction Methods

There is a large amount of rock work on the line, with heavy rock cuts, and much of the material at the north end of the line is used for filling the site of the yard at Radnor. Well-drills are used largely for the blast holes. Most of the work is handled by steam shovels, served by either narrow-gage or standard-gage dump cars (mainly the former), in trains hauled by contractors' light locomotives, temporary trestles being used largely for dumping the fills.

Many of the cuts had to be taken out in two lifts. One long and heavy cut near Brentwood, 10 mi. below Nashville, had about 80% solid rock, the remainder being earth cover. The steam shovel first excavated this earth for a width sufficient to carry a construction track outside the line of the rock cut. Then when the shovel handled the rock cut it loaded the rock into cars on this upper track. In this way the dump-car trains could be handled much more efficiently than on a stub track at the level of the shovel track in the bottom of the cut. On this piece of work a 60-ton shovel was served by two 10-car trains of 4-yd. dump cars handled by two 10-ton locomotives, the length of haul to the fill being about 3000 ft.

Fig. 7. Train of 16-Yd. Air-Operated Dump Cars and Spreader Car on Company Force Construction Work; Louisville & Nashville R.R.

The work was divided into 25 contract sections of 8 to 10 mi. in length, while one 12-mile section was built by company forces as noted below.

Construction by Company Force

The improvement work on that part of the line between Athens and Decatur, 12½ miles, is of particular interest from the fact that it is being done by company forces instead of by contract. This is partly on account of the high bids received and partly on account of the fact that the work of grade and curve revision involves considerable interference with the existing line, so that it would be convenient for the company to handle both the regular traffic and the construction trains. At two points it was necessary to build temporary main-line diversions in order to enable work to be done on the old line. This section of the work is in rolling country, running into swamps near the Tennessee River.

Equipment was purchased to the value of about $90,000, including a 90-ton steam shovel, standard gage 16-yd. air-operated dump cars, a spreader car, a concrete mixing plant, and a locomotive piledriver for temporary trestles, etc.

The handling of the equipment and work is in the hands of Theodore Speiden, Roadmaster of the Nashville-Decatur division, whose authority corresponds to that of a contractor's superintendent on contract work, while the engineers keep close record of the work and progress in the same way as on contract work. The resident engineer is C. H. Crawford.

The results have been so satisfactory that other work will be handled in this way and additional equipment is being purchased. In one month, working 10-hr. shifts, the steam shovel moved 60,000 yd., which is considered about the highest record for shovels of this size. This is due largely to the use of a 4½-yd. bucket, and large dump cars. In a year's work, the cost was considerably below the lowest bid which had been received.

Organization and Force—In the system of organization work done by company force, the limits of responsibility have been clearly established. Within these limits the construction department is responsible for maintenance, construction and operation. The resident engineer takes the place of the contractor's superintendent and directly supervises all of the various details through subordinates as well as in person. The purchase of equipment is done through the regular channels, and repair work on the equipment is done at the shops.

The number of men engaged is about 165, distributed as follows, but this number varies between tolerably wide limits as the undertaking progresses.

Engineering and Superintendence:
- 1 resident engineer
- 1 supervisor of construction
- 1 instrument man
- 2 rodmen
- 2 axemen
- 1 clerk and stenographer in resident engineer's office
- 1 accountant in roadmaster's office

Steam Shovel
- 1 shovel runner
- 1 cranesman
- 1 fireman
- 1 watchman
- 6 pitmen

Work Trains:
- 3 locomotive enginemen
- 3 conductors
- 3 brakemen
- 1 engine watchman
- 2 coal heavers

Bridging:
- 2 bridge foremen
- 2 piledriver enginemen
- 2 piledriver foremen
- 1 watchman
- 2 bridge crews of about 12 men each

Spreader:
- 3 spreadermen
- 1 dumpman
- 2 gin hands

Concreting:
- 1 foreman
- 1 engineman for mixer (handy man)
- 15 men in concrete crew

Track Work:
- 3 extra-gang foremen
- 2 assistant foremen
- 75 men (negros) divided into three extra gangs
- 3 section foremen
- 24 men divided into three section gangs

Miscellaneous:
- 1 pumper
- 3 telegraph operators
- 1 carpenter foreman with about 10 men taking care of buildings

Equipment

1 class 80 Atlantic steam shovel with tank and shop complete. 7000 gal. tank in addition to tanks on shovel. 1 Bucyrus locomotive pile driver with extra tank, 5000 gal. Combination convoy and shop car. 1 small hoisting derrick. 3 80-ton 2 : 8 : 0 locomotives with two tanks each. 30 K & J automatic dump cars, 16-yd. 3 standard cabooses. 1 Edson diaphragm pump. 1 Jordan steel dirt spreader. 1 Smith concrete mixer, capacity about ½ cu.yd. per batch. 32 boarding and camp cars.

Accounting System—The accounts are kept with particular care. The charges for labor are made by the distribution as shown in the various time books which are carefully checked as the work progresses. Notes are kept from day to day to facilitate this checking up at the end of each month. A chart has been prepared which includes all of the various sub-headings. All material bills, labor and repair charges, interest and depreciation, as well as miscellaneous charges of any kind, are properly distributed and carefully tabulated at the end of each

month, so that the chart grows as the work progresses.

All work done by the construction forces which, under the contract system, the railway ordinarily would do but which a contractor would not do, are accredited to the grading as "extras."

Work of the Public Service Commission for the First District, State of New York

The annual report of the Public Service Commission for the First District, of the State of New York, was presented to the State legislature on Jan. 19. The commission's work consists largely in supervising the design and construction of rapid-transit systems in New York City. It is shown that the investment of the city in the present rapid-transit subways in $56,007,194 and that contracts totaling $93,864,437 have been let for work on the new dual subway system. This is about half the sum the city is to expend. The Commission has disbursed $14,000,000 already to 18 contractors, employing 8000 men. The Commission's engineering force in field and office is about 1000 men.

Aside from this construction work, there are 159 companies in Greater New York City under the regulation of the Commission. Of these, 33 are under jurisdiction only in special matters. Of the 126 under general jurisdiction, 28 are inchoate or dormant, leaving 98 operating or lessor. Of these, 68 are transportation and 30 are gas- and electricity-supply concerns. The total capital stock and funded debts of these 98 companies is $1,173,630,574.

The Commission in 1913 authorized the issue of $287,342,000 in stocks and bond issues, making a total of $517,535,219 since July 1, 1907, when the Commission was established. Besides this, $7,244,000 in applications was withdrawn; $182,616,622 was disallowed, and $53,650,716 is still pending.

An idea of the magnitude of the public utilities in Greater New York is gained from the figure of $152,029,179 as the total earnings last year of its transportation, gas and electricity companies. This amounts to about $30 per capita (on a basis of 5,000,000 population). Of this enormous sum $87,717,359, or over half, was paid in fares on the transportation systems, which carried 1,769,889,284 passengers. This was 5.29% more than in 1912. These railway fares amount to $17.50 per capita. The electric-current revenue was $29,990,908. The gas revenue was $34,319,912.

The Commission asks for an appropriation of $1,500,000 as the State's share in the expense of elimination of grade crossings in Greater New York. Under previous legislation the cost of this work is to be borne one-half by the railroad, one-fourth by the state and one-fourth by the city. The commission is unable to proceed with this work until the state's share is appropriated, and no appropriation has been made since 1911. However, 25 crossings were eliminated in the year on work ordered in 1910 and 1911, reducing the number of dangerous crossings to 452. Thirteen people were killed and 18 were injured during the year at these points.

The total accidents on the transportation lines in this district was 71,631, which was 1087 more than in 1912. In these accidents 31,149 passengers were injured, 7568 employees and 6643 others. In these accidents, 319 persons were killed and 2352 seriously injured.

Progress on Building Construction for the Panama-Pacific Exposition

The erection of the wooden-frame exhibit buildings for the Panama-Pacific International Exposition, to be held in San Francisco, Calif., in 1915, is being vigorously prosecuted. This will be better appreciated if the photograph here reproduced (taken Jan. 1, 1914) is compared with the one taken from the same position in September, 1914 (Fig. 1, in the long article by A. H. Markham, Assistant Director of Works, for the Exposition, in ENGINEERING NEWS, Nov 6, 1914, p. 895).

VIEW OF EXPOSITION BUILDINGS UNDER CONSTRUCTION, LOOKING TOWARD THE GOLDEN GATE, JAN. 1, 1914

In September, practically no work had been done above the foundations, while the present photograph shows the great change which has taken place. Fourteen of the exhibit buildings are now under construction, some of which have reached the height of 160 ft. When completed, the tallest structure will be the Main Entrance Tower—430 ft. in height.

Performance of the Municipal Asphalt Repair Plant at Niagara Falls, N. Y.—A report of the work performed by the municipal asphalt repair plant at Niagara Falls, N. Y., during 1913, was recently presented by F. S. Parkhurst, Jr., City Engineer, to the Board of Public Works. The operation of the plant covered a period of 97 actual working days.

A total of 3088 batches of topping was made during that time—an average of 32 per day, or 35,512 cu.ft. There were actually laid on the streets 17,364 sq.yd. of topping with an average thickness of 2¾ in., or 179 sq.yd. per working day.

There were required for repairs due to pavements cut by public service corporations, etc., 2472 sq.yd. of asphalt topping. In addition to the topping, 1932 cu.ft. of binder were made. The cost of production was as follows:

	Topping	Binder
Square yards	17,367	1,008
Cost per sq.yd.	$0.71	$0.66
Cu.ft.	35,412	1,932
Cost per cu.ft.	$0.35	$0.34
Total cost	$12,369	$664

About 100 tons of asphaltic cement were purchased under competitive conditions at $20 per ton. The average unit cost of laying the municipal asphalt since 1912 has been 74c. per sq.yd. as against the average price of $1.34 per sq.yd. charged by contractors, from 1907 to 1911, inclusive.

Quay Walls at Nantes, France

Two types of quay walls of radically different design are now being constructed in the harbor of Nantes, France, on the Loire River, in connection with an enlargement of the port there. The first type, shown in Fig. 1, is now under construction in an extensive new section of the harbor. The second type, in Fig. 2, is a survival in reinforced concrete of a timber design which has been used for some years as an extension of existing walls of the old masonry retaining-wall type.

The first type is essentially a concrete retaining wall tied back by rods to deadmen in the earth fill and resting on a concrete slab, which in turn foots on reinforced-concrete piles reaching down into the river bottom and side slope. In its final appearance this design is similar to many others common to European ports, but the peculiarity lies in the fact that the base concrete of the quay was placed in separately molded reinforced-concrete cribs. These cribs, which were 39.4x27 ft. in plan and of the general section shown in the detail in Fig. 1, were

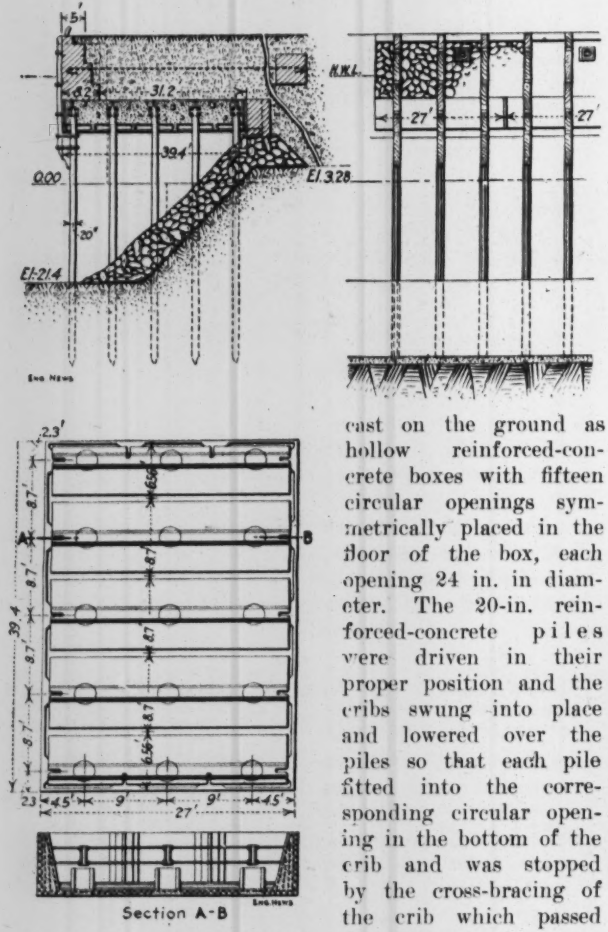


Fig. 1. New Quay Walls at Nantes, France

cast on the ground as hollow reinforced-concrete boxes with fifteen circular openings symmetrically placed in the floor of the box, each opening 24 in. in diameter. The 20-in. reinforced-concrete piles were driven in their proper position and the cribs swung into place and lowered over the piles so that each pile fitted into the corresponding circular opening in the bottom of the crib and was stopped by the cross-bracing of the crib which passed directly over the opening. The whole crib was then filled up with concrete to make a solid box, the outside gravity wall tied in with rods to the deadmen which were of concrete in 80-in. cubes, and the intervening space filled with earth to make the quay wall. This wall is to be some 5600 ft. long.

The structure shown in Fig. 2 is, as stated above, an evolution of old timber trestles which were [illegible] beyond the masonry retaining walls to extend [illegible] of the quay. Of late, however, these extensi[illegible] been built of reinforced concrete in the gen[illegible] shown in the figure. In building this extens[illegible] forced-concrete piles are first driven into the s[illegible]

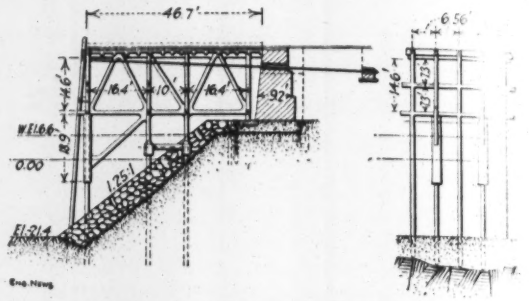


Fig. 2. Reinforced-Concrete Extension to Old Masonry Quays, Nantes, France

and on them reinforced-concrete columns are cast, and are braced together in the truss section shown. A reinforced-concrete floor with ordinary paving is also provided and the whole structure is tied back at intervals to the deadmen as shown in the figure.

A Reinforced-Concrete Sheet-Pile Sea Wall

A sea wall made up of specially designed reinforced-concrete sheet-piles is now being placed along the whole water front of the City of Bay St. Louis, Miss. Some 1500 ft. of the wall has already been constructed and the contract is about to be let for the remaining 8000 ft. of the city which fronts on the Gulf of Mexico. Fig. 1 shows the rear of the completed section of the wall. The city is contemplating filling behind the wall as here shown with sand pumped from hydraulic dredges working in the harbor.

Fig. 1. A View of the Rear of Reinforced-Concrete Sheet-Pile Sea Wall at Bay St. Louis, Miss.

Fig. 2 gives the details of the sheet-piling in the sea wall. It consists of a series of tongued-and-grooved concrete sheet-piles sunk to a firm bearing in the sand and tied back to deadmen every fifth pile to give lateral rigidity. Additional rigidity is also given by the continuous concrete coping.

The piles are cast in a yard on wooden pallets with sides of 24-gage, galvanized iron. Each pile is 20x9 in. in section with the curved tongues and grooves shown in the cut, and is reinforced with continuous ⅝-in. rods through the entire 20-ft. length and by 1-in. rods through the lower section. A hole 4 ft. from the top is provided for hoisting the pile and for fastening the forms for the coping. The ⅝-in. rods protrude above the top of the piles and are bent to take a horizontal continuous ⅝-in. rod, the whole of which forms a reinforcing for the continuous concrete coping which is cast on the top of the piles after they have been driven.

The piles are aged for 28 days and are then carried by

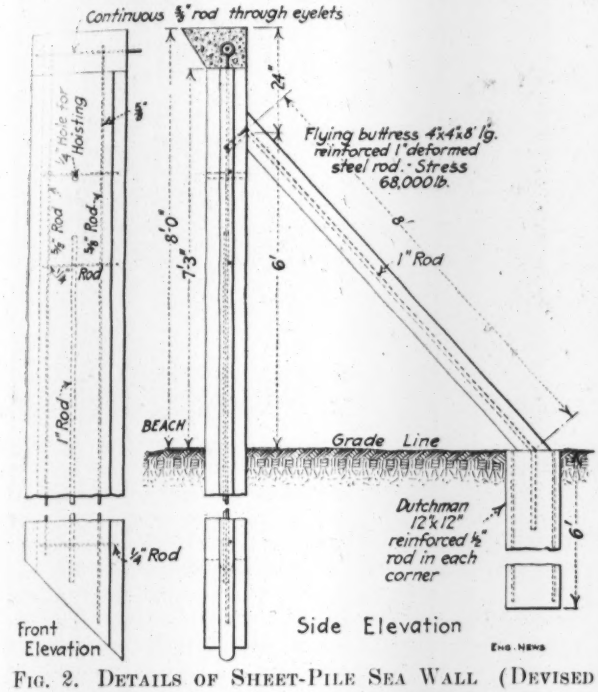


FIG. 2. DETAILS OF SHEET-PILE SEA WALL (DEVISED BY T. L. TRAWICK, NEW ORLEANS, LA.)

log carriers to the place of driving, where they are driven by the water-jet method. Every fifth pile is anchored back to a 12x12x72-in. deadman by 1-in. twisted rods, which in the design are intended to be covered with concrete but which in the section so far erected have been left bare, as shown in Fig. 1.

The pile was originated by T. L. Trawick, of New Orleans, and is being built by Burton Victor, who holds the patents for its design. The cost of the wall is estimated in the present case to be about $10 per running foot completed.

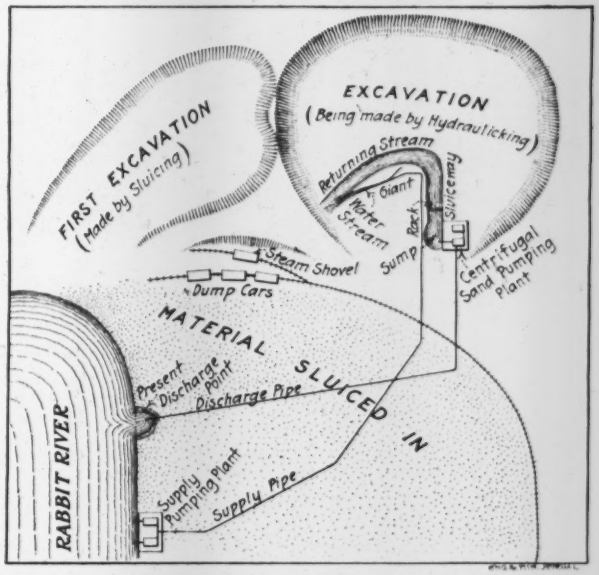
A Hydraulic Excavation Plant on Ore Stripping Work

Stripping the overburden from an orebody by water jets has been employed with success by the Pittsburgh Steel Ore Co. at its Rowe mine, on the Cuyuna iron range in northern Michigan, although the general practice in that district is to use steam shovels. The following description if from an article by L. O. Kellogg in the *Engineering and Mining Journal*, Jan. 17.

The orebody is on one side of a bayou or widening of Little Rabbit River, the top of the overburden reaching a considerable elevation above the water and the top of the ore lying about 20 ft. below the water. A dike of impervious clay protects the pit from flooding by the river.

A pumping plant was established on the river bank and water piped to the hill over the ore and there discharged. This simple sluicing operation was extremely efficient for a time, the returning stream of water carrying a full burden of material into the river. As the dip of the hill was washed away, however, the grades became too low and the action of the water much less efficient. Resort was then had to the hydraulic method. This is shown in the accompanying cut (which is not made to scale).

Two plunger pumps deliver water to a 12-in. pipe line about 1500 ft. long, leading to the center of the excavation and supplying an ordinary hydraulic giant; a 10-in. pipe is used for the last few hundred feet of the line. The débris is washed down a rough sluiceway to a sump, where a centrifugal sand-pump delivers it to a 12-in. pipe which discharges it on the edge of the bayou, about 1000 ft. away. The supply pumps have two horizontal plungers each and are gear driven by electric motors. They have together a rated capacity of 3500 gal. per min. Nozzles of different diameters are used. The capacity of the centrifugal pump is



HYDRAULIC EXCAVATION FOR STRIPPING AN OREBODY

5000 gal. The pump is belt driven by an electric motor. The static head is about 28 ft. It is a matter of some care to keep this pump working at the proper rate to take care of the supply of material. The larger boulders, as well as brush and roots, are eliminated by a rack or screen.

The overburden is easy to handle, being fine and unconsolidated glacial drift. The only boulders found lie immediately above the ore. The method proved remarkably cheap, but with the installation in use was somewhat slow, and for that reason a steam shovel was added to the equipment in order to hurry the completion of the stripping and also because hydraulicking is not practicable in the coldest weather.

Power of the Kansas Public Utilities Commission over rates of the Wyandotte County Gas Co., was affirmed in a decision of the U. S. Supreme Court, Jan. 5, 1914, on a writ of error. A lower court had enjoined the company from charging over 25c. per 1000 cu.ft. for natural gas supplied to domestic consumers in Kansas City and Rosedale (Kansas). The company claimed that (1) its contract with the city of Kansas City, secured under earlier legislation, relieved it from obtaining the consent of the Commission, and (2) that the decree of the lower court impaired its contract rights in disregard of the Constitution. The Supreme Court held that the contract was made under legislation, regulating cities of the first class, which provided that the rates of public utilities in general should be reasonable and just, in spite of allowing certain franchises and contracts to be made to induce service. Therefore, it was impossible for the city to contract away the governmental power to forbid unreasonable and to secure reasonable rates.

A 70-ft. 37-Ton Railway Gasoline Motor Car

A type of railway motor car which is in extensive use in this country is the McKeen gasoline car, having direct chain drive from the engine shaft to the driving axle. In Fig. 1 is shown a recent car of this type, built for the Morgan's Louisiana & Texas Ry., this being one of three cars built for the Sunset-Central Lines.

The driving truck, shown in Fig. 2, forms a complete power unit, the 200-hp. six-cylinder engine being mounted upon the cast-steel truck frames and power being transmitted to the leading axle by a driving chain. This chain passes over a sprocket wheel on the crankshaft and a similar wheel carried by a sleeve on the axle. This latter wheel forms part of a multiple-disk friction clutch which can be connected directly to the axle or connected to it through a set of back gears (with herringbone teeth) by means of a sliding clutch. Both clutches are operated by compressed air. The mechanism is very similar to that of the four-wheel gasoline freight and switching engine described in ENGINEERING NEWS, of Oct. 16, 1913, except that this engine had all its wheels the same size, and had the rear axle driven by outside coupling chains.

The machinery and moving parts are inclosed, and automatic lubrication is provided so that the motorman can give all his attention to driving the car. An auxiliary hand-oiling device for the crank and rod bearings is provided to facilitate lubrication in starting on a cold morning or to cool a hot bearing. The valves are made of tungsten steel to eliminate all chance of distortion by heat. The driving truck requires but little attention on the road, and it is stated the length of time it will run before going to the repair shop depends almost entirely upon the wear of the driving-wheel tires.

The car is of all-steel construction and conforms to the builder's standard design. The pointed parabolic "windsplitter" front end is occupied by the engine room, 13 ft. 4 in. long, behind which is a baggage and express room 8 ft. 6 in. long. A 32-in. central vestibule with inclosed steps separates the smoking compartment (16 ft. 4 in.) from the main compartment at the rear, this latter being 28 ft. long, with a semicircular rear end and seat. The seating capacity is 29 for the forward and 54 for the rear compartment, or 83 in all. The windows are similar, except that the head end has large rectangular windows, giving a good view for the motorman. The car is fitted with air brakes and M. C. B. couplers. The dimensions are as follows:

Length over end sills	70 ft. in.
Width over side sills	9 ft. in.
Width inside	9 ft. in.
Width overall	10 ft. in.
Height, inside, at center	7 ft. in.
Height, rail to top of car	11 ft. in.
Weight in working order	lb.
Driving wheels (2)	ft. in.
Truck wheels (6)	ft. in.

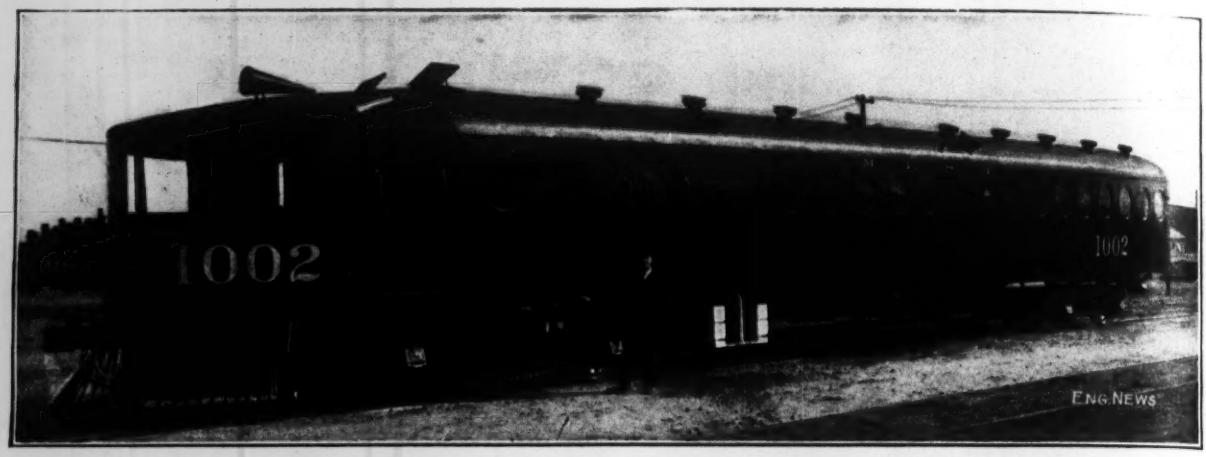


FIG. 1. GASOLINE MOTOR CAR FOR THE MORGAN'S LOUISIANA & TEXAS R.R. MCKEEN MOTOR CAR CO. OMAHA, NEB.; BUILDER

There are now 141 of the McKeen cars in service, and 57 railways are either operating or have ordered them. Seven of the cars are on government railways in Australia, two of these being of 5-ft. 3-in. gage and the others of 3-ft. 6-in. gage. Four years ago, when we described a car for the Oregon Short Line,* there were 59 cars in service on 24 railways in this country and Mexico. It is stated that a car in service for seven years has recently made a record in running 5000 miles in a month, earning $117 per day, at a total operating charge

*"Engineering News," Jan. 20, 1910.

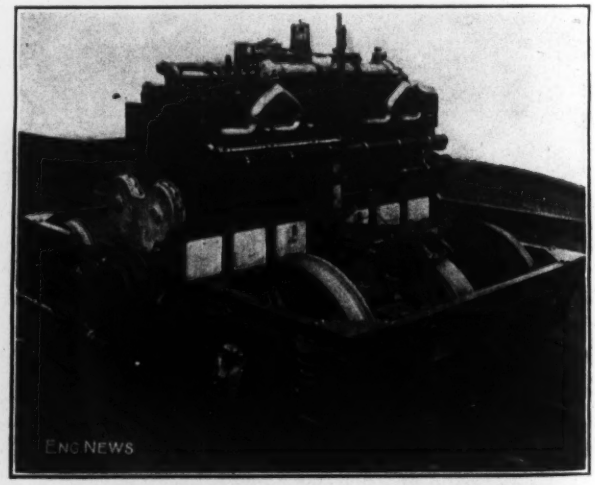


FIG. 2. GASOLINE ENGINE AND MOTOR TRUCK OF THE MCKEEN CAR

of 14c. per mile. This type of car was invented some years ago by W. R. McKeen, who was then Superintendent of Motive Power of the Union Pacific Ry., and is now President and General Manager of the McKeen Motor Car Co., of Omaha, Neb.

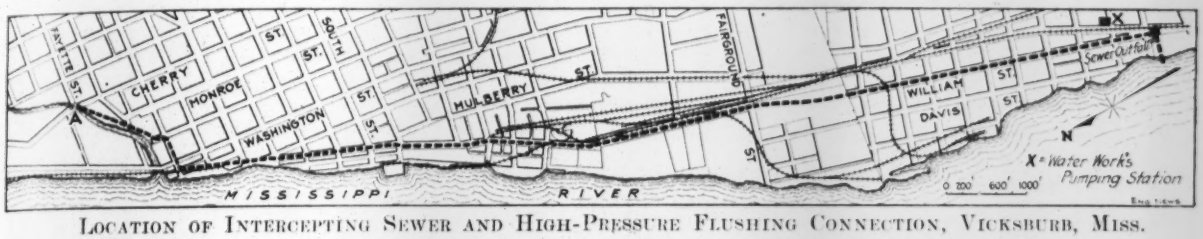
How Is This as a Substitute for Pumping Sewage?

By Horace M. Marshall*

Vicksburg is a "City set upon a hill" and it has ever been *sui generis*.

The sewerage system of Vicksburg was planned by Walter G. Kirkpatrick, with Hering and Fuller as consulting engineers, and it was built for the city under their direction.

The drainage shed runs about parallel with the city front, some four city blocks back from the river. The slope of the four front blocks is directly toward the river and the larger area at the rear drains into a bayou, which empties into the river several miles below town. The intake and pumping station of the water-works are on the river bank below the town. As the sewage is discharged into the river, it was necessary to place the sewer outfall below the water-works pumping station to avoid contamination of the water-supply. This necessitated an intercepting sewer along the whole city front (see accompanying map). It is below high water over its entire length—some 3 ft. below at the upper end and 20 ft. below at the outfall.



Location of Intercepting Sewer and High-Pressure Flushing Connection, Vicksburg, Miss.

The designers contemplated utilizing the flow from the back sewerage area, coming from a high level through a railroad cut in the hill near the outfall, to pump that from the front area coming down the intercepting sewer. They found, however, that it would not operate a large enough pump. In fact, the larger discharge comes from the intercepting sewer. Accordingly, an electric-driven pump was installed in a well at the outfall to lift the sewage from the intercepting sewer while the river is at flood stages—usually three or four months each year. This pump was used for several years at a cost to the city of some $500 a month to pump the sewage.

The intercepting sewer extends from Glass Bayou to the outfall, about two miles. The sewer is 22 and 24 in. in diameter at the upper part and 27 in. for the lower mile. A pipe 18 in. in diameter runs down along Glass Bayou from where it crosses Cherry St. (marked "A" on the map) and joins a 22-in. pipe which runs into the intercepting sewer. The elevation at "*A*" is 17 ft. above high water. Glass Bayou never "goes dry."

Filtered water furnished "99% pure" by the Water Works company is too good to flush sewers. C. R. Twiss, city engineer, installed a flushing tank last year at "*A*," on the 18-in. pipe, and tapped Glass Bayou with a 12-in. pipe to connect with it. In the spring of 1913 the river was higher than ever before but no pumping was needed at the outfall. Of course not. There was 17 ft. head on the intercepting sewer above high water. That looks like some saving to the city—though none of it has been given its engineer.

It may be added that the intercepting sewer is of ordinary vitrified pipe, laid with cement joints, and that there are no check valves to prevent back flow into the sewers. An inspection of the lower end of the 27-in. portion of the sewer disclosed no defects, nor have evidences of defects been seen at the street surface. When the river was up water came through the perforations in the manhole covers at the lowest point of the 24-in. portion of the intercepting sewer. Four sacks of earth placed on the manhole covers stopped the outflow.

While the head at the flush tank is 17 ft. above high water in the river, it is certain that the sewer is nowhere under anything like that pressure. The lower end of the sewer fills only enough to cause a flow into the river, no matter what the river stage may be.

*U. S. Assistant Engineer, Vicksburg, Miss.

The Carelessness of Drivers and Pedestrians at Grade Crossings were recently emphasized by Justice Greenfields, of Canada, in disposing of a damage suit involving the death of a man who was driving a team of horses attached to an empty wagon, down a steep hill leading to the Canadian Pacific R.R. tracks, and was killed by a train. A clear view of the tracks was presented and safety required only that the driver "stop, look, or listen." In dismissing the suit the Justice said:

> A person approaching a railway crossing, knowing it to be such, must know at the same time that he is confronted by an ever-present possibility of a train passing; he must furthermore know that such train has a right to pass such crossing—possibly as good or even a better right than he has to cross—and he must know that the crossing of the train may be fraught with danger to himself. In the presence of this possible danger common prudence, not to say common sense, renders it incumbent upon that person to take every precaution. If he fail to do this, and if he run into the train—instead of having the train run into him—then so much the worse for that person. He alone is responsible for what occurs.

A Mine-Fire Gallery has been built by the U. S. Bureau of Mines at its Pittsburgh experiment station. This is a steel tube 6½ ft. in diameter and 27 ft. long, laid in a deep trench, lined with firebrick and mineral wool, covered with 2 ft. of earth, and with its ends stopped by 13-in. brick walls. The chamber has been made as nearly airtight as possible and insulated against the escape of heat generated within. At one end is a motor-driven fan and air meter, while at the other is a stack which can be opened or closed. At intervals along the top of the gallery are small pipes for withdrawing samples of air or gases inside, or for inserting pyrometers. The gallery will hold six to eight tons of coal when one-third full. It is intended to place different kinds of coal or waste in the chamber and study spontaneous developments under various conditions. Experiments are planned on controlling fire by reducing air supply or sealing. Progressive changes in composition of the gases, etc., will be followed out and temperature measurements made to secure data for solving practical problems in subduing mine fires. It is claimed that this is the first attempt to investigate this problem with experimental apparatus on a mining scale and with full control of surrounding conditions.

A Reinforced-Concrete Girder and Slab Bridge with Pre-Cast Members

A reinforced-concrete girder and slab bridge, footing on concrete pile piers, has recently been built near Easton, Md., across the Miles River, one of the many estuaries making up from Chesapeake Bay on the "Eastern Shore" of Maryland. The bridge is extremely simple in design, but is distinguished further because a number of its members were cast in a yard at Baltimore, Md., 60 miles away, and brought to the site on barges.

A timber pile trestle highway bridge about 1075 ft. long and 16 ft. wide existed at the site for about 60 years, crossing the river, which is 15 ft. deep at the channel, its deepest part. This channel was spanned by a 30-ft. draw span. The replacement of the bridge by one of more permanent construction and more pleasing appearance had long been desired and was made possible in 1912-13 through the coöperation of Talbot County and of the State Road Commission of Maryland. General plans and specifications were prepared by the State Road Commission, and alternative plans and specifications for the design were invited. As the result of this, the Commission decided on the plans here illustrated, and the bridge was built as shown.

The old structure had to be frequently renewed, mainly on account of the action of the teredo on the pile piers. The Road Commission, therefore, decided that it would be best to provide a permanent structure of concrete with a steel bascule bridge to span the necessary channel, and as clearance was required only at the channel, a low pile, girder and slab structure was recommended. The design shown herewith was adopted for the above reasons. The method of pre-casting some of the members was dictated by the following considerations: (1) The site of the bridge is about three miles from the nearest town, Easton, Md., making labor rather difficult to obtain. (2) The banks of the river are occupied by fine country estates, making it difficult to secure land for casting the concrete piles. (3) It would have been necessary to transport concrete materials by barges to the bridge site, from the same source as for the concrete cast in the yard at Baltimore. (4) The water along the river bank is so shallow that it would have been difficult to land the material, and later to pick up the cast piles preparatory to placing them.

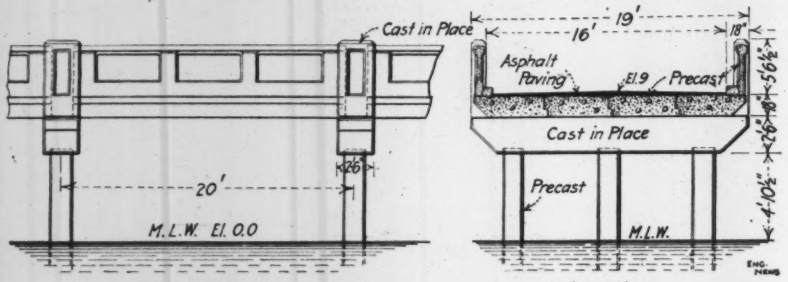


FIG. 1. DETAIL OF TYPICAL SPAN OF MILES RIVER BRIDGE, TALBOT CO., MD.

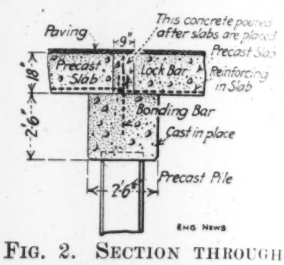


FIG. 2. SECTION THROUGH TYPICAL FIXED BENT (Railing not shown.)

It was, therefore, apparent that the adoption of any plan permitting the casting of as much as possible of the concrete work at a more convenient and accessible place would effect a considerable saving in cost, since it would reduce to a minimum the amount of labor necessary at the site, and would eliminate the necessity of leasing expensive land, even if it could be obtained at any price, for casting piles. Further, it would eliminate the necessity of constructing a temporary wharf for the un-

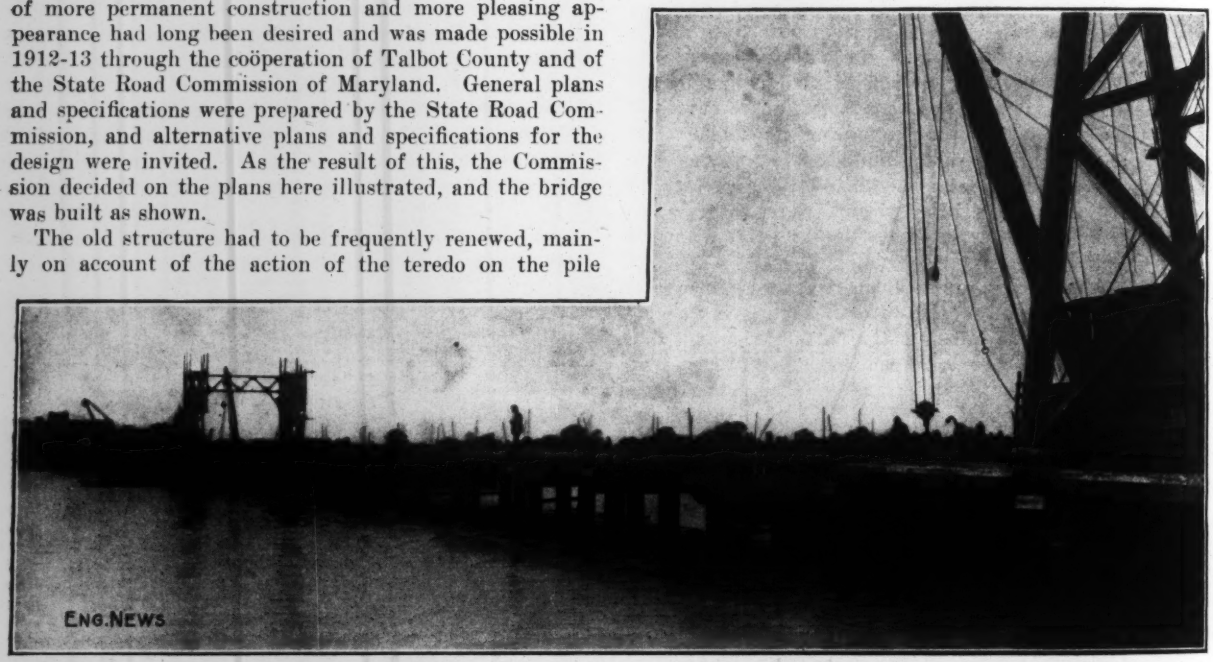


FIG. 3. VIEW OF MILES RIVER BRIDGE UNDER CONSTRUCTION

FIG. 4. CONCRETE SCOW WORKING ALONGSIDE OF PILES AND FLOOR-BEAM FORMS

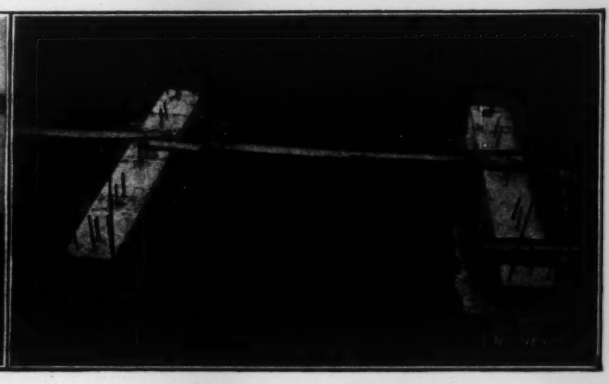


FIG. 5. FLOOR-BEAMS STRIPPED OF FORMS

FIGS. 4-5 CASTING THE FLOOR-BEAMS, MILES RIVER BRIDGE

loading of concrete materials, and the subsequent loading of the cast piles. As to towing charges it was estimated that it would cost little, if any, more to tow scows with the pre-cast members than to tow scows with the required concrete materials.

It was, therefore, decided not only to cast the piles in Baltimore and tow them to the site on scows, from which they could be readily picked up and placed by a derrick scow located at the bridge site, but to effect an additional saving by so designing the bridge that the reinforced-concrete slabs for carrying the roadway, and the reinforced-concrete railing slabs could also be cast in Baltimore, transported to the site and put in place by the same derrick scow. This plan made possible the fabrication of a large portion of the bridge under favorable conditions for the securing of economical material, labor and land for casting. The plan necessitated only the casting at the bridge site of the reinforced-concrete pile caps or floor-beams, the posts between adjacent railing slabs, the abutments for the main bridge, and the mass concrete piers for the drawspan.

The bridge has a 16-ft. roadway and a total length of 1075 ft., made up of fifty-one 20-ft. fixed girder spans of the standard size and design described below and one 40-ft. drawspan. The two abutments and the two piers for the drawspan are of mass concrete.

Each span is made up of 18-in. thick reinforced-concrete floor slabs, spanning 20 ft. between transverse reinforced-concrete floor-beams, which cap three concrete piles, driven to refusal into the silt, clay and sand bottom of the river. Each trestle bent consists of three reinforced-concrete piles, each 18 in. square, and ranging in length from 38 to 54 ft., to meet varying conditions as regards depth of water and firmness of bottom, and reinforced with rods at the four corners. The floor-beams are 30 in. wide and 30 in. deep, as shown on Fig. 1, and are reinforced to meet ordinary highway loading. The floor slabs are each 19 ft. 3 in. long, and 18 in. deep. also reinforced. They were cast in four separate pieces, each 4 ft. 9 in. wide, to facilitate casting and handling.

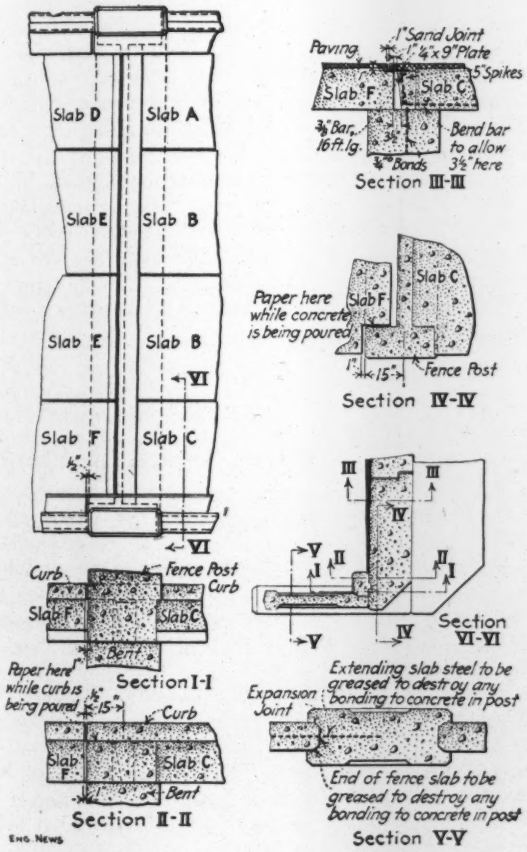


FIG. 6. DETAILS OF EXPANSION JOINT

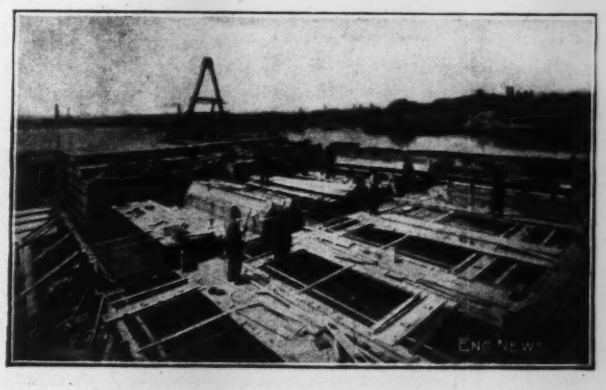


FIG. 7. VIEW IN CASTING YARD AT BALTIMORE, MD.

The ornamental railing, of the type shown in Fig. 1, was also cast in lengths 19 ft. 3 in. long.

The piles were brought to the job on scows and were placed by a 15-ton derrick scow equipped with heavy pile leads, a large high-pressure pumping plant, hoisting engine, swinging engine, and auxiliary machinery necessary for work of this character. The piles, the heaviest of which weighed approximately 9 tons, were jetted to initial bearing and finally driven to required depth and bearing by a 6000-lb. drop hammer. In nearly every case, the pile used was too long, and the concrete was cut off to the level of the bottom of the floor-beam by small shots and the steel sawed off with a hacksaw.

When the pile was brought to this level, supports were clamped around each pile and a form in which the floor-beam was to be built was placed upon the clamp. A view of two of these is shown in Figs. 4-5. Concrete was made on a barge equipped with a mixing plant and taking material from another barge.

After the beams had set, the forms were removed and the floor slabs brought in on the derrick scow and laid on the floor-beams, leaving an opening of 9 in. between the adjacent floor slabs over each floor-beam. Into this opening the steel rods of the floor slabs projected horizontally and steel rods from the floor-beams projected vertically, as shown in the detail in Fig. 2. These projecting rods were well tied together and the 9-in. space concreted flush with the floor slabs, making a continuous and monolithic structure between the expansion joints noted further below.

The floor slabs, as shown on Fig. 1, were provided with lapped joints across the bridge, and were laid without mortar joints. After the floor slab had been cast, the railing slab, which was also 19 ft. 3 in. long, was placed, leaving a 9-in. opening over the bent, into which projected the steel from the floor-beam and steel from the railing. Around this opening, a form was built to give shape to the post and steel having been well tied together, the post was poured.

The roadway curbs were next placed, and were securely anchored by means of a groove in the upper portion of the roadway slab, with steel projecting upward from the groove into the curb. The roadway was given a slight crown, with concrete laid in place, and an asphalt surface placed for the final roadway.

The entire number of concrete piles in the bridge is 158; roadway slabs, 204, railing slabs, 102.

At intervals of 100 ft. (every fifth span), expansion joints (shown on Fig. 6) were located in the roadway slabs, curb and railing slabs. These joints were made, as shown, by carrying the roadway across an opening on a plate anchored to one slab and resting with a sliding joint on the adjacent slab. The details are well given in the figure.

The channel is spanned by a rolling-lift bridge of the Scherzer type, of 40-ft. clear span.

Fig. 7 shows the yard in Baltimore where the piles roadway slabs and railing slabs were cast. Fig. 3 shows the bridge under construction, with the arrangement of the reinforcing rods at the end of the road slabs and at the side of the bridge immediately over the bridge parapet indicated.

With the exception of the Scherzer rolling-lift drawspan, the entire bridge structure was designed and built by the Raymond Concrete Pile Co., 140 Cedar St., New York City. The Chairman of the Maryland St[illegible] Roads Commission was O. E. Weller, and the Chief [illegible]neer, H. G. Shirley. The contract price for the conc[illegible]truc-ture complete, with paving, was $52,450. The [illegible]tract price for the Scherzer rolling-lift bridge was $5[illegible] making the total cost of the entire structure comple[illegible] ready for traffic, $58,440.

Reinforced-Concrete Retaining-Wall of Pedestal Construction

By E. G. Kaufmann*

In connection with a street crossing of the Canadian Northern Ry. in a northern Ontario town, although it is necessary to depress the roadway to provide for clearance, it is required that the sidewalk be kept at its original elevation. This necessitates the construction of retaining-walls extending about 110 ft. on each side of the bridge, the wall being 6 ft. high above the gutter at its highest point. The design shown herewith was made for this crossing.

Wall Piers on Piles

As the soil is poor, it was decided to place the wall on piles to prevent cracking due to unequal settling. The bridge abutments—already built—are on piles. The foundation of such a wall, if made continuous, would be much the largest item of cost, as it must be carried four feet deep on account of the heavy frost. In order to reduce the cost of the foundation, the piles were placed in groups of four piles each, placed 12 ft. on centers, as shown in the sketch. Each group of piles was capped with a concrete pedestal which in turn carries the wall.

The portion of the wall immediately above the pedestal, marked *bc* on the front elevation, is reinforced vertically, to act as a vertical cantilever supported by the pedestal. The part *ab* of the wall, between pedestals, is reinforced horizontally to act as a slab supported at each end by the cantilever portions, and resisting the horizontal earth thrust of the backing. The function of the railroad rail is to support the wall between foundations.

Analysis of Design

An analysis of the design of the wall at the point where it is 6 ft. deep will be given:

The magnitude of the earth thrust is found by Rankine's formula,

$$P = (\tfrac{1}{2} wh^2 + vh) \tan^2 (45° - \tfrac{1}{2}\phi)$$

where

w = weight of earth, lb. per cu.ft., taken as 100 lb. for moist soft clay;

v = imposed load, including sidewalk, lb. per sq.ft., in this case 150 lb.;

h = height (6 ft.);

ϕ = angle of repose, taken for earth as 32° 41′.

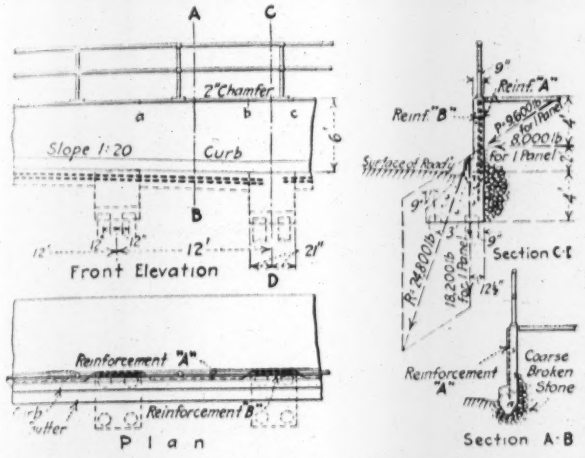
The thrust P will then act on the angle of natural slope, and is applied 4 ft. below the sidewalk. From the formula its amount is 806 lb. per lin.ft. of wall. Since the wall extends 1 ft. below the gutter the general tendency might be to use $h = 7$ ft., but it must be re-

*Engineer's Office, Mackenzie, Mann & Co., Ltd., Toronto, Ont.

member that at this point the wall is supported laterally by the gutter and is also reinforced by the extra concrete in the curb.

The overturning force to be resisted by one pedestal consists of the earth pressure on one entire 12-ft. panel, which is 9600 lb., acting as shown. This overturning load is resisted by the weight of one pedestal plus 12 ft. of wall = 18,200 lb., acting through their center of gravity, 15½ in. from the back of the wall. The weight of earth on the pedestal is neglected, being very small. The resultant R is found graphically to be 24,800 lb., and falls within the middle third of the pile spacing. Since about two-thirds of this load comes to the front piles, the load which each of these has to carry is about 8300 lb., which is entirely safe.

It has been suggested that the width of the pedestal (along bc) might be decreased, and two piles used instead of four. Although the wall would probably furnish sufficient lateral support to make this safe, we are inclined to hold to the arrangement of four piles in order to secure greater stability.



Pedestal Retaining-Wall at a Street Undercrossing in Ontario, Canadian Northern Ry.

A spacing of 2 ft. between piles may be considered too small for convenience in driving, but we have successfully driven piles with this spacing.

It will be noted that before the earth backing is replaced practically the entire weight of the concrete falls upon the rear piles, but as the load on each pile is then only 9100 lb., it is safe. Also, since this weight falls a little to the left of the rear piles, the wall will not tip over backward.

We now come to the design of the slab ab. The pressure of 800 lb. per foot of the wall has a horizontal component of 666 lb. This is the total pressure on a portion of wall 1 ft. wide and 6 ft. high. The average pressure is then 111 lb. per sq. ft. Since the maximum is twice the average, we have 222 lb. per sq.ft., applied at the bottom of the wall. As the cantilevers are 3 ft. wide, a span of 12 ft. for the slab would be excessive. The span is, therefore, taken as 10 ft., this overlapping the cantilever supports sufficiently.

For this span and loading a 9-in. slab reinforced with 0.45 sq.in. of steel per foot width, imbedded 1½ in. in the concrete, is needed. This steel area is required at the bottom of the wall only, but as mesh is used it must be carried to the top. This mesh is referred to as "*Reinforcement A*" on the sketch. The original assumption of a 9-in. wall is therefore correct as far as we have gone.

The bottom of the wall, section ab between pedestals is made wedge-shaped, as shown on section B-B, in order to minimize the pressure due to heaving effect of the soil on account of frost. Broken stone will be placed beneath the wall for this reason, as well as for drainage. We have found that water freezing in coarse broken stone produces less heaving than in soil.

Owing to the unusually heavy frost in this locality, it may be decided to carry the entire wall down below the frost line. However, under milder weather conditions the device shown should be satisfactory.

The cantilever b-c will now be considered: As the vertical reinforcing mesh will be placed in a 3-ft. width, the section of the cantilever will be 36x9 in. Since the reinforcing is embedded 2 in., the effective depth at a point just above the curb is 7 in. The resultant load on the cantilever is equal to the horizontal thrust of the earth for the 12-ft. panel, or 8000 lb., applied 1 ft. above the top of the curb. The moment at the top of the curb therefore is $M = 96{,}000$ in.-lb. From formula or diagrams we find that the steel required is 0.38% and $f_c = 430$ lb. per sq.in. The steel required is then $0.0038 \times 7 \times 12 = 0.32$ sq.in. per foot width.

Considering the point of connection of the cantilever with the pedestal, $b = 36$ in., $d = 15$ in., and $M = 24 \times 8000 = 192{,}000$ in.-lb. The steel required is found to be 0.18% and $fc = 250$ lb. per sq.in. Then the steel area is $0.0018 \times 12 \times 15 = 0.33$ sq.in. per foot width. A mesh having 0.35 sq.in. per foot width will be used. This is referred to as "*Reinforcement B*" on the sketch.

An old steel railroad rail is placed under the center of gravity of the wall, to support the wall between pedestals where it has no base. It is strong enough to carry the weight by direct beam action, and being readily at hand, is cheap.

Weep-holes are to pass through the curb to drain the backing into the gutter.

A wall of this form might be used even without piles, as the unit-pressure on the soil will not be very great, but great care must be taken, for if one pedestal should settle more than another the wall would crack.

⁂

The Tower Grove Grade-Crossing Elimination, now commenced at St. Louis, Mo., is a complicated piece of work involving two railways (with a connecting track between them) and two main thoroughfares having double-track street railways, besides other adjacent streets. At this point Tower Grove Ave. and Vandeventer Ave. intersect at an acute angle between the track of the Missouri Pacific Ry. and the St. Louis & San Francisco Ry., and the grade crossing will be eliminated by an approximately equal elevation of streets and depression of tracks. The depression on 0.5% grades involves a total of approximately 1½ miles of double-track main line, a somewhat greater length of side tracks, a number of industrial connections, and a double-track main-line railway crossing at grade.

Tower Grove Ave. (60 to 80 ft. wide) and Vandeventer Ave. (60 ft. wide) will cross the tracks on reinforced-concrete bridges, with approach grades of 3½%. Four other streets, not crossing the tracks, are affected by the raise in grade. The work will be carried out under a contract ordinance of the city of St. Louis with the railway companies, the latter assuming the cost of construction (approximately $500,000), and the former assuming the consequential damages to private property. Each company will perform a definite portion of the work, the Missouri Pacific Ry. employing its own forces and the St. Louis & San Francisco Ry. doing its work partly or entirely by contract.

Construction Work for East St. Louis Flood Protection

SYNOPSIS—A description of some of the more important construction work done by the East Side Levee and Sanitary District in the vicinity of East St. Louis, Ill. This project consists in the drainage and flood protection of 150 sq.mi. of area in the heart of a rich agricultural and industrial region. The district is lower than the flood plane of the Mississippi River, requiring extensive levee construction for protection, and the flood conditions have been aggravated by high water in smaller streams which flow through the District. The most important of these is Cahokia Creek, the main flow of which has been diverted direct to the river several miles north of the old location. Previous articles on this project have appeared in our issues of Nov. 28, 1907, Feb. 2, 1911 and Aug. 28, 1913.

SIZE AND ORGANIZATION OF DISTRICT—The East Side Levee and Sanitary District in which the city of East St. Louis, Ill., is located, is a municipality chartered by the State of Illinois and given power to levy taxes to provide flood protection and drainage for a 150-sq.mi. area situated on the east side of the Mississippi River opposite the city of St. Louis, Mo. The area extends about 30 miles along the Mississippi River and is bounded on the east by a chain of bluffs. Besides East St. Louis the district contains the cities and towns of Granite City, National City, Madison, Venice, Brooklyn, Nameoki, and Cahokia (see map, Fig. 1).

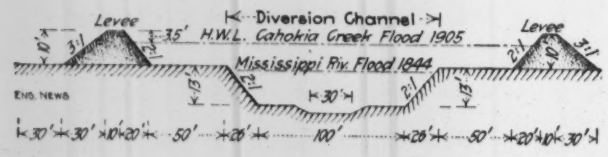


FIG. 2. CROSS-SECTION OF THE CAHOKIA CREEK DIVERSION CHANNEL

The district as a municipality embraces a large territory including the cities mentioned, but is in no way directly connected with them; it is governed by a Board of Trustees elected every four years, which appoints a chief engineer, a treasurer, a clerk and attorneys. The President of the Board of Trustees receives for his services a salary of $2000 a year, while the other members are paid $1000 a year. The Board of Trustees is endowed with the necessary legislative power to enact tax ordinances and provide for the collection of taxes and is empowered with the right of eminent domain. The property valua-

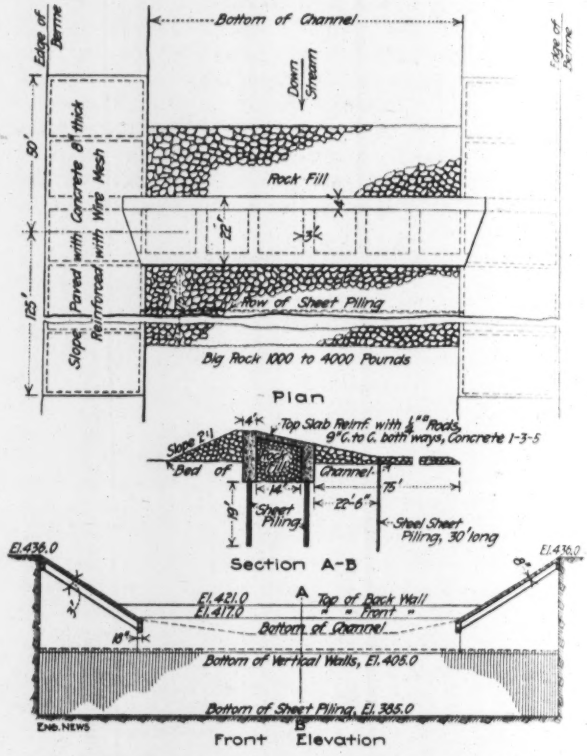


FIG. 4. CHECK WEIR AND DROP, CAHOKIA CREEK DIVERSION CHANNEL

tions in the district exceed $100,000,000.* The estimated cost of the work provided for in the present plans of the East Side Levee and Sanitary District is $6,500,000.

CAUSES OF FLOODS—In order to appreciate the significance of the measures taken by the East Side Levee and

*Information furnished by W. N Aubuchon, Jr., Manager of the East St. Louis Industrial League, and T. N. Jacob, Chief Engineer, Cahokia Bldg., East St. Louis, Ill.

*For a more detailed description of the character of the district and its commercial importance, see article "Levee and Drainage Project at East St. Louis, Ill.," by T. N. Jacob, "Engineering News," Feb. 2, 1911, p. 132.

FIG. 5. CONCRETE WALL LEVEE AT MITCHELL, ILL.

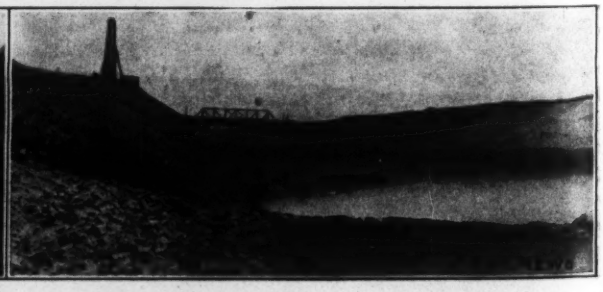


FIG. 3. CAHOKIA CREEK DIVERSION CHANNEL AT LOW WATER

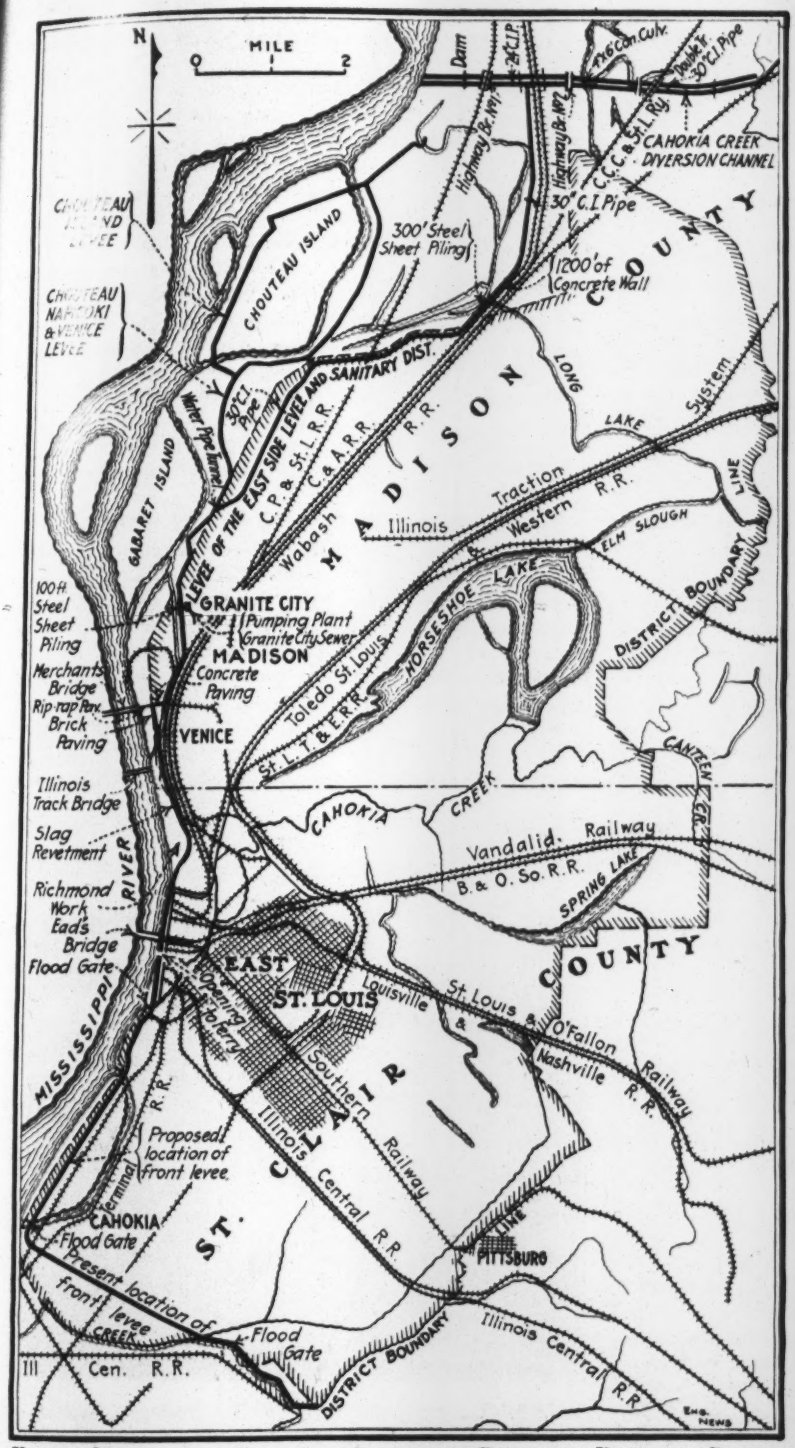


FIG. 1. MAP OF THE EAST SIDE LEVEE AND DRAINAGE DISTRICT, SHOWING FLOOD PROTECTION WORKS

Sanitary District to guard against future floods in this area it will be necessary to get a clear understanding of the causes of the frequent floods.

The area of the district is comparatively low, and the Mississippi River formerly spread itself over a large portion of it; while through the area runs a stream called Cahokia Creek, and to the northwest is a 200-sq.mi. plateau which forms its watershed. Practically all of the rainfall of the plateau was formerly carried through the lower area by Cahokia Creek to the Mississippi River. In the event of a heavy rainfall the water from the plateau would augment the drainage of the lowland, and Cahokia Creek would overflow its bank in the lower area.

High water in the Mississippi River and in Cahokia Creek would frequently occur at the same time, and the river water backing up the channel of the creek would result in a disastrous overflow. These overflows occurred frequently and caused great inconvenience to traffic and devastation of property. Keeping the Mississippi River out of the area was simply a matter of building a levee high enough, but harnessing Cahokia Creek was a problem presenting a number of difficulties.

DIVERSION CHANNEL AND FLOOD GATES—The Cahokia Creek problem was partly solved by a diversion channel—a canal which conducts the headwaters of the creek westward by a direct line to the Mississippi River. The diversion channel relieves the lower area of the drainage of the plateau. The channel is 100 ft. wide at the bottom and 13 ft. deep (Figs. 2 and 3). On both sides are dikes 10 ft. high, built of the clay taken from the channel.

The excavation of the diversion channel required the construction of five railway bridges and four highway bridges, where the channel crossed these highways. These bridges were built entirely at the expense of the East Side Levee and Sanitary District. Where the improvement of the channel of a stream necessitates the alteration or reconstruction of a railway bridge, the railway company, under the Illinois law, is obliged to pay the expense of the work; but the diversion channel being an entirely new work, and in no sense a stream improvement, it was decided that the district should pay the entire expense.

At a distance of four miles from the head of the diversion channel is a 7-ft. dam (Fig. 4), on each side of which for a distance of about 250 ft. the banks are protected with a facing of concrete and riprap, 2 ft. thick. The purpose of the dam is to check the velocity of flow in the channel.

The flow of water which is now passing through the diversion channel, a distance of 4½ miles, formerly traveled about 30 miles through the lower area to the Mississippi River. The level of the bed of the diversion channel at its head is about 25 ft. higher than the low-water level

in the Mississippi River, so that the water in the channel, if it were not for the dam, would be falling at a rate of about 5 ft. to the mile, which is, of course, too high for safety to the clay banks. The dam allows the water in the diversion channel to have a fall of 2 ft. to the mile. Beyond the first check weir is a pool for about 200 ft., where there is another check weir dropping the water to the Mississippi River level below. The diversion channel, including bridges, dikes and dams was built at a cost of $850,000. The estimated cost was $1,200,000.

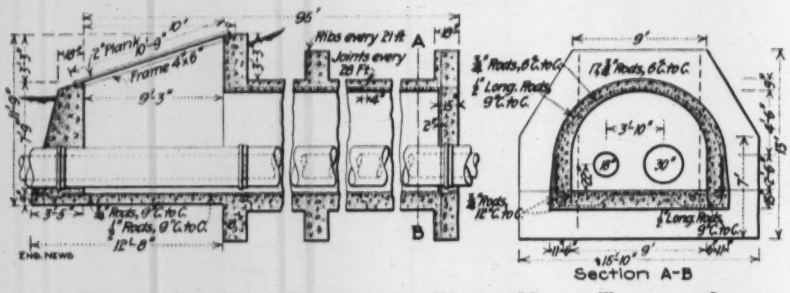


FIG. 6. CONCRETE TUNNEL FOR WATER MAINS THROUGH LEVEE

LEVEE—To protect the area against the high water of the Mississippi River a levee has been built 31 miles long and 3½ ft. higher than the highest flood record, which was in 1844, and 7 ft. higher than the flood record of 1903.

The levee begins at a point just west of the crossing of the Alton, Granite & St. Louis Traction Co. tracks with the diversion channel. Here the levee is about two miles from the Mississippi River. There was no engineering reason for building the levee so far from the river through this section; but the property owners in that territory which lies west of the levee did not care to bear their proportion of the expense, so the levee was built along the least expensive route, which is back of their property, leaving them exposed to the Mississippi River high water.

Owing to the topographic conditions at Mitchell it was impracticable to build a clay levee of standard proportions, so here a 1200-ft. concrete wall, 5 ft. wide at the bottom, 2 ft. wide at the top, and 5 ft. high, was built (Fig. 5).

Leaving Mitchell the line of the levee is southwest to a point opposite Chouteau Island, about ten miles north of East St. Louis. Continuing to the southwest the levee again approaches the river front, just above Venice.

FIG. 7. LEVEE WITH REINFORCED-CONCRETE APRON, MERCHANTS' BRIDGE APPROACH

Provision had to be made for the drainage and water-supplies of Granite City, Venice and Madison. During high water the drainage of these three communities has to be pumped under the levee through a concrete sewer; at low water it flows out by gravity. The water-supply of Granite City, Venice and Madison, which comes from the river, is pumped through pipes which run under the levee. To guard against any damage to the levee which might result from the bursting of one of these pipes a concrete jacket was built around that section of each which is immediately under the levee (Fig. 6).

The drainage of the roads along the inner side of the levee is conducted through the levee by automatic flood gates, which hang vertically and operate like flap-valves. When the Mississippi River water is high, its pressure closes the gates. When the river recedes the drainage water presses against the gates and opens them. Hand-operated gate valves were installed at the intake ends to prevent the influx of water in case the automatic flood gates should fail.

On the southern outskirts of the city of Madison the levee reaches the river front at the Merchants Bridge. The bridge approach is utilized for about 1500 ft. as a part of the levee scheme. The upstream side of the approach which is exposed to the current of the river is protected with a 6-in. reinforced-concrete apron (Fig. 7). The levee connects with the east end of the Merchants Bridge approach on the north and with the west end of it on the south. The current of the Mississippi River strikes the bridge aproach on the north and whirls around the west end where the current is very great. Just south of the bridge aproach the levee is protected with a heavy facing of riprap (Fig. 8). North of the bridge approach revetment the only protection of the clay levees against wash is a turf of blue grass. Later it is planned to surface the entire levee with concrete. South of the ridge the levee is covered with slag, obtained without cost, from the steel foundries in the neighborhood, it being a waste

FIG. 2. LEVEE WITH RIPRAP REVETMENT, SOUTH OF MERCHANTS' BRIDGE

product. It is placed upon the levee with a quantity of foundry sand and it has been found equal to rock riprap as a means of protection. The action of the elements upon the slag and foundry sand mixture causes it to pack and form a solid mass with a hard surface. The slag is obtained at a saving of about 66⅔% over the cost of rock. Along the front of the city of East St. Louis much of the levee is confined between reinforced-concrete retaining walls.

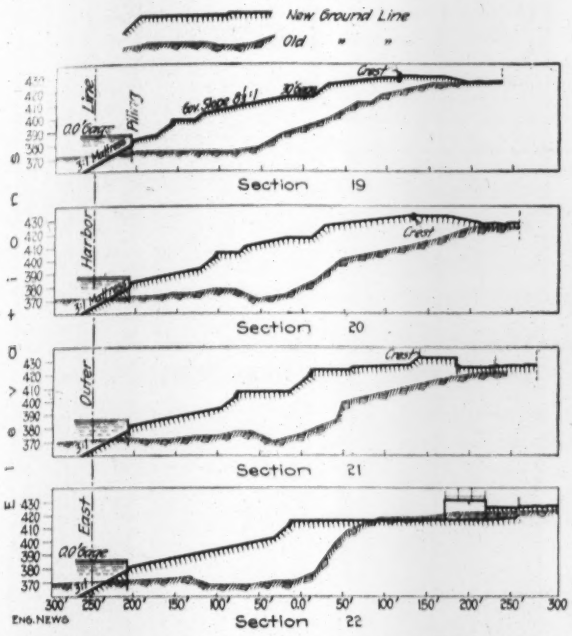


FIG. 9. TYPICAL PROFILE OF LEVEE AND RECLAMATION WORK, EAST ST. LOUIS, ILL.

Just north of the city of East St. Louis the District Board and the property owners are reclaiming about 150 acres between the levee and the river by dredging sand and silt from the river bed. This part of the work and the electrically operated hydraulic dredge "St. Louis," which is employed to make the fill, were described in our issue of Aug. 28, 1913. Fig. 9 shows typical profiles of the levee and reclamation scheme in front of the city.

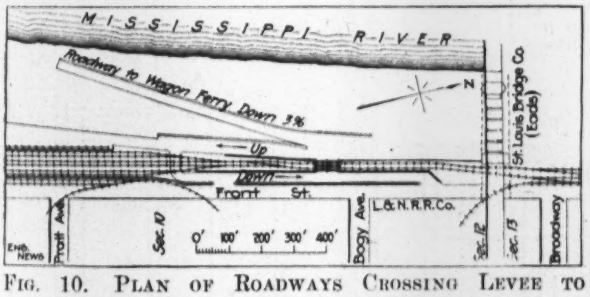


FIG. 10. PLAN OF ROADWAYS CROSSING LEVEE TO FERRIES

On either side of the Eads Bridge (see Fig. 1) are important ferry stations. To provide access to these and to the wharves at each of these points two special passes through and over the levee have been provided, the first to be used when the river is at normal level and the second when the river is high.

A plan of one of these roadway crossings is shown in Fig. 10. The same crossing under construction is shown in the view Fig. 11. The entrance to the pass under the levee is approached on a 3% down grade, the upper end of which may be closed during high water by a clay-filled bulkhead. The roadway in the opposite direction leaving over the top of the levee is on a 4% grade. An elevation of the street side of the roadway pass and typical sections of the retaining walls are shown in Fig. 12.

For three miles in front of East St. Louis, a limestone wharf is being built, extending from the top of the levee wall to the shore line, sloped 1 on 8. In building the levee

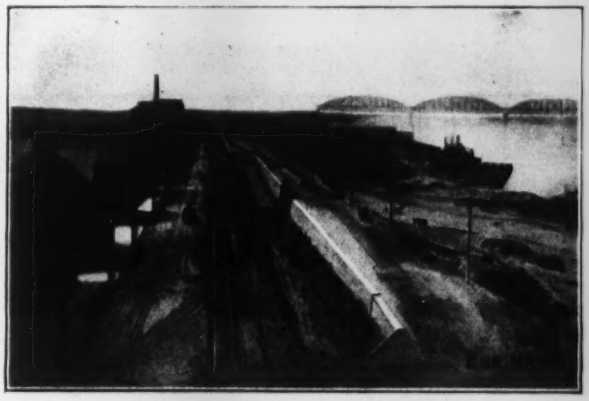


FIG. 11. RIVER FRONT LEVEE, EAST ST. LOUIS, ILL.; VIEW TAKEN FROM EADS BRIDGE; ST. LOUIS MUNICIPAL BRIDGE IN DISTANCE

along the city water-front the growth and development of the river traffic which should result from the 14-ft. Mississippi River channel project and the completion of the Panama Canal has been anticipated. The levee wall in front of East St. Louis for a considerable distance is about 10 ft. higher than the street level, while the Mississippi River at low stage is considerably lower than the street level.

CAHOKIA CREEK FLOOD GATES—At the present southern extremity of the city levee are the three flood gates at the mouth of Cahokia Creek. These gates and the culvert through the levee are shown in detail in Fig. 13. The river side of the culvert is protected by about 125 ft. of steel sheet-piling, driven in the face of the levee at right angles to the axis of the culvert.

The gates are of steel, the framework being of 8-in. 23-lb. I-beams, with 8-in. 21¼-lb. channels at top and bottom. They are covered on the front face with ⅜-in. steel plates. The three gates are hung vertically, one above the other, on 1½-in. pin hinges. The gate frames are of 8x16-in. timbers faced with 8x8x¾-in. steel angles. Other details are shown in the illustration.

LEVEES SOUTH OF CAHOKIA CREEK—The levee south of the mouth of the creek are clay dikes like those north of Madison. It is proposed to extend the levee system to the south and east as shown on the map, Fig. 1.

PROPOSED DRAINAGE SYSTEM—The East Side Levee and Sanitary District is now working out a comprehensive drainage system for the area, which will probably include the transformation of Cahokia Creek into a large drainage sewer. In the immediate future a drainage canal is to be dug on the east side of the area, to be about 40 ft. wide and run parallel to the bluffs, to carry the drainage of the bluffs and the eastern and southern por-

tion of the area. The canal will be 7 miles long and empty into the Praire Du Pont Creek (see Fig. 1).

PERSONNEL—The flood-protection work of the East Side Levee District dates from the flood of 1903, at which time the East Side Levee Association was organized. The East Side Levee Association raised a fund of $25,000 and formulated a plan which resulted in the organization, by a special act of the Illinois Legislature in 1907, of the East Side Levee and Sanitary District. The East Side Levee and Sanitary District made its first survey in the year 1909, and began the levee work in 1910, under the direction of T. N. Jacob, Chief Engineer, and Col. J. A. Ockerson, Consulting Engineer. Later the office of Consulting Engineer was abolished and Mr. Jacob was given entire charge.

The East Side Levee Association plans were carried out in part by Mr. Jacob, but an important part of the work, the diversion channel, was substituted by Mr. Jacob for a drainage canal, which according to the East Side Levee Association plans, was to conduct the Cahokia Creek water through the southern part of the lower levee to the Mississippi River.

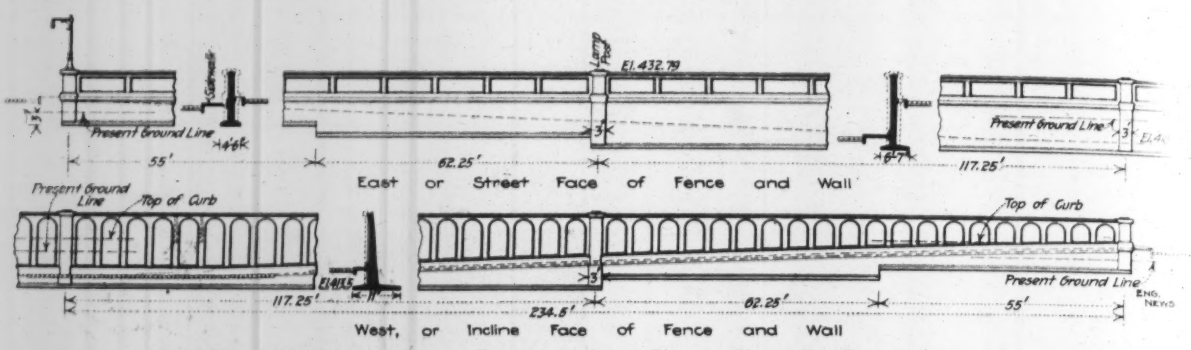


FIG. 12. ELEVATION OF ROADWAY OVER LEVEE, EAST ST. LOUIS, ILL.

Uniformity of Gage on Australian and Indian Railways

The controversy over the railway-gage problem in Australia has been settled by the acceptance of the 4-ft. 8½-in. gage as standard by a conference of engineers representing the five states which were formerly independent colonies but are now federated in the Australian

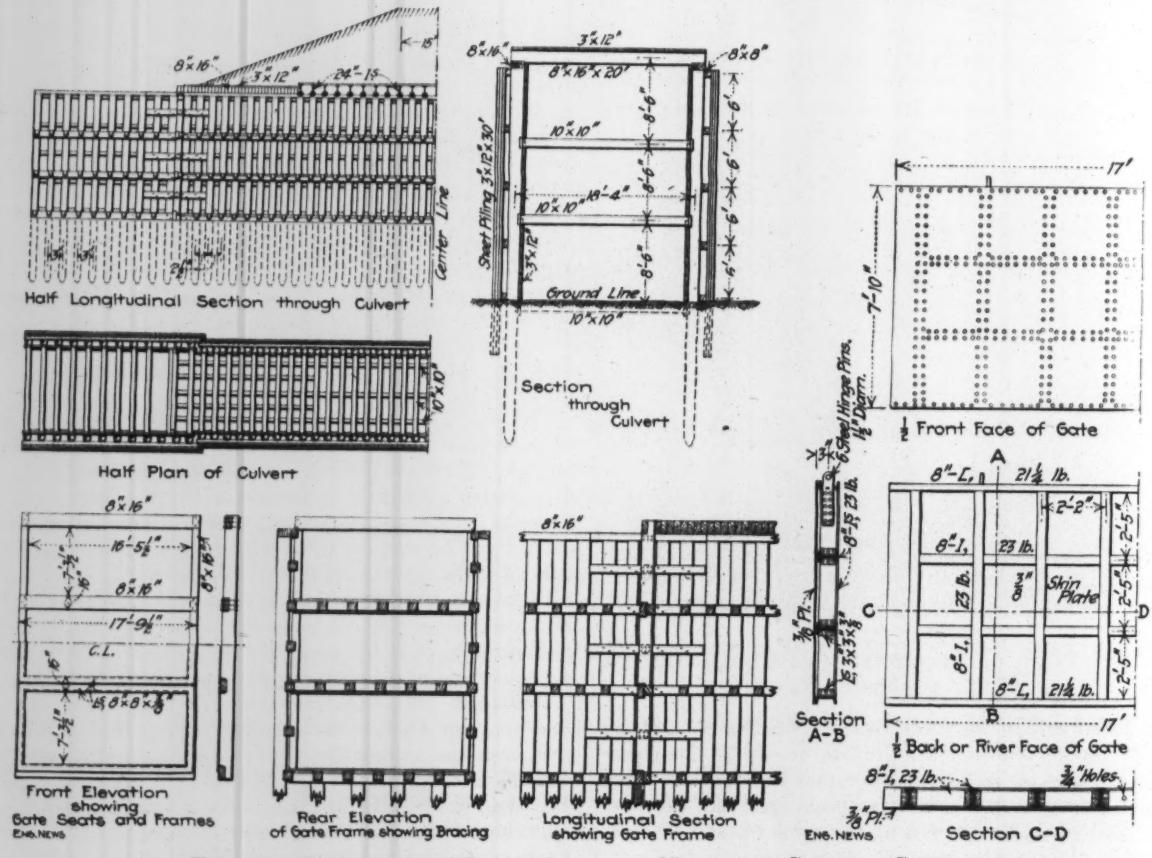


FIG. 13. CULVERT AND FLOOD GATES AT MOUTH OF CAHOKIA CREEK

Commonwealth. In the early days, the engineers of each colony adopted the gage which appeared to them most suitable, with the result that the standards included 5-ft. 3-in., 4-ft. 8½-in., and 3-ft. 6-in. Trouble began when the railway systems developed connecting lines, but for many years the trouble was not very serious, as the populated districts are mainly along the coast line and there is ample navigation service for freight traffic.

The question of uniformity of gage has been discussed many times, and a few years ago the decision to build a transcontinental line to connect the eastern and southern states with the growing district on the west coast, brought matters to a head. This feature was discussed in our issue of Dec. 7, 1911, and eventually the 4-ft. 8½-in. gage was adopted for this important railway. There still remained, however, the decision as to a uniform standard gage for all the Australian states. The 3-ft. 6-in. gage was recognized as out of the question, and the main controversy was in regard to the respective merits of the existing gages of 4-ft. 8½-in. and 5-ft. 3-in.

During all the years of controversy and delay the problem has been becoming more and more serious, due to the growth of commerce and railway traffic and to the continual extension of the railway systems on the several gages. Thus the longer that action is delayed, the greater will be the cost of the necessary changes. For this reason the board of engineers has recommended that work on the unification of gage should be commenced without further delay. It remains to be seen what action will be taken by the government.

There are now about 3800 miles of standard-gage 4-ft. 8½-in. lines (all in New South Wales), 4200 miles of 5-ft. 3-in. gage and 8500 miles of 3-ft. 6-in. gage. In other words, a change of gage has to be made on 12,700 miles of railway. Just how the work is to be organized and how the change is to be made are problems for the railway engineers to determine. The cost is estimated at an average of $17,500 per mile for widening the narrow gage and $8500 per mile for reducing the wide gage.

This brings up again the question of unification of gage in India, where there are several extensive railway systems on two such diverse gages as 5-ft. 6-in. (Indian standard gage) and 3-ft. 3⅜-in. Some of these systems are isolated, while others are interconnected to some extent. Several years ago it was proposed to lay a third rail on some of the broad-gage lines in order to link up isolated meter-gage lines, but this would have been only a partial remedy. The desirability both from the commercial and the military standpoint, of a uniform gage and free interchange of traffic has been put forward many times. In January, 1913, there were about 17,200 miles of line on the standard gage of 5-ft. 6-in., and 14,200 miles of meter-gage lines. The cost of widening the latter was estimated some years ago at $15,000 to $17,500 per mile.

A Combination Cesspool and Septic Tank

By J. F. Duling*

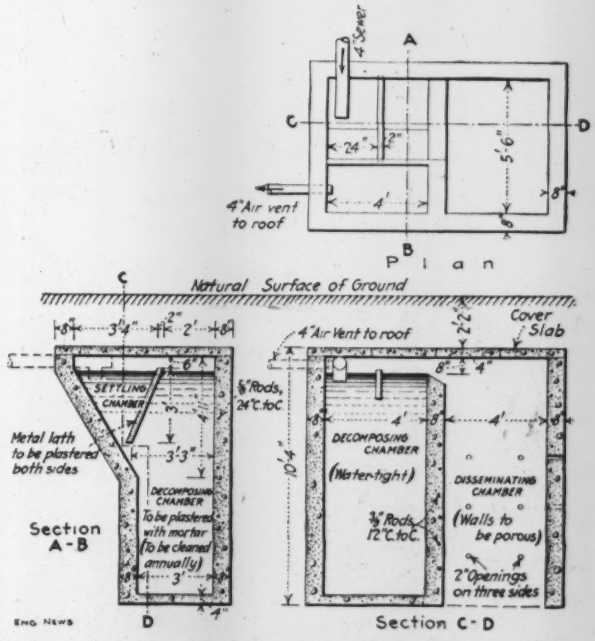
When a cesspool is installed in a district which draws its domestic water-supply from shallow wells it is very important that the effluent be as harmless as possible.

*Civil and Mining Engineer, 625 South Hill St., Los Angeles, Calif.

It is believed that the cesspool illustrated by the accompanying drawing will prove very much less objectionable than the old type of cesspool. It was designed by the writer for an office and store building in the town of Le Grand, Calif. The water-supply of the town comes from individual wells, and as yet no sewerage system has been installed.

The conditions were about as follows: A top soil of sandy loam from 6 to 7 ft. in depth, then gravel, with the first water plane at 15 ft., separated from a second water strata which was encountered at 60 ft.

All wells were drilled to the second water level and the ground water shut off. The building was a two-story reinforced-concrete and tile structure, having a frontage of 200 ft., divided into eight stores with offices above.



A Combined Cesspool and Septic Tank for an Office and Store Building

To suit these conditions, a two-compartment cesspool was designed. The first compartment is a small settling basin and sludge decomposing chamber, with water-tight walls. It has an air vent run to the roof of the building. To provide for the rapid dissemination of the effluent from the settling basin, the second compartment was constructed with porous walls and no floor. On account of the shallow depth of the ground-water plane, it was necessary to make the disseminating chamber rather shallow.

The tank was located in the alley back of the building at the farthest point from the water-supply. The plan called for a covering of 2 ft. 2 in. of soil over the tank as a protection from the traffic through the alley and to prevent the escape of objectionable odors. A 4-in. vent up the back of the building to the roof provides for the escape of gases.

A Steel Bridge 1¼ Miles in Length and consisting mainly of forty 150-ft. spans has just been completed by the Bengal Northwestern Ry. Co. across the Jumna River at Allahabad, India.

The Testing of Sand for Use in Concrete--I. Field and Laboratory Practice

By Cloyd M. Chapman*

The following description of the methods of manipulation to be followed in the making of the various tests on sands was originally prepared for the use of the operators in the laboratory of Westinghouse Church Kerr & Co. The fact should be borne in mind that these directions are intended only for the use of the person performing the mechanical manipulations, which provide the data from which may be computed the various characteristics of the sand. By means of the data produced as a result of the

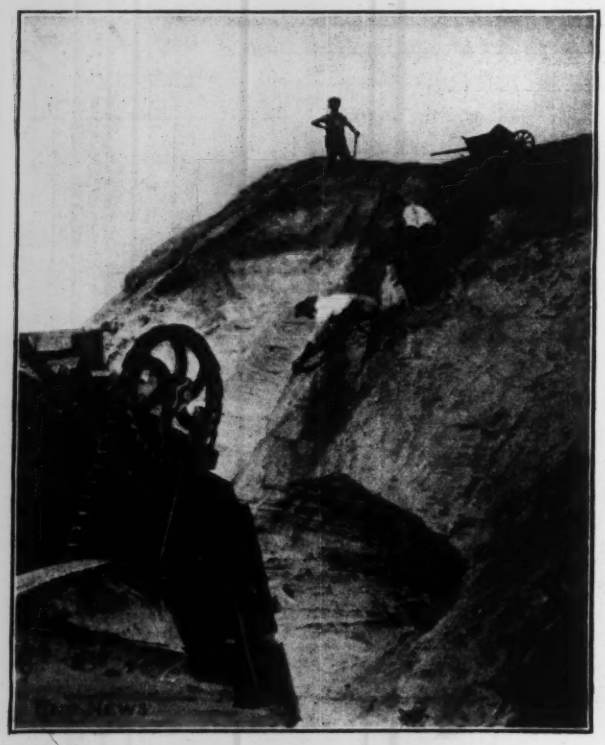


Fig. 1. Sampling Sand in the Bank

carrying out of the processes here described the engineer may compute the numerical values of the qualities it is desired to know, such as the specific gravity, voids, etc. In other words, the following description covers only the gathering of the data and not the computation of results from that data nor the interpretation of those results and their application to practical use. In a later article these questions of computing results, interpreting and applying them will be treated.

Another point which should be made clear is that not all of these tests are of a proved value in determining the availability of a sand for use in concrete. There is no claim or pretention that it is either necessary or even desirable to make all of the tests here described before one is able to decide whether a sand is or is not suitable for a given purpose.

The whole question of sand testing is as yet so little understood and reliable data on the subject are so scarce that it is considered advisable to perform many tests of doubtful value for the sole purpose of gathering data which might be of value in a broad study of the question. By accumulating data of this kind it is hoped that it may be possible later to pick out from the many tests a few which will adequately serve the purpose. Several of the characteristics of the sand are determined by two or more methods in order that ultimately an intelligent choice may be made of the better method.

The question of methods of taking samples is a very important one, and should receive most careful attention. The value of a test is entirely dependent upon the degree of accuracy with which the sample of sand represents that from which it was taken. And this accuracy is in turn very largely dependent upon the method used in taking it and upon the care with which the method is carried out. It is not generally realized how variable sand from the same bank usually is and how much more difficult it is to obtain a truly representative sample of a variable material than of a fairly uniform material such as cement. To test an improperly taken sample of sand is not alone a waste of the time and money involved in making the test but may lead to much greater loss if the results of the test are used in specifying proportions for large quantities of concrete. It is probably true that the one most important step in the testing of a sand is the taking of the sample. In spite of its great importance it has been found by correspondence with more than twenty of the leading laboratories in this country in which sand is regularly tested, that not one single laboratory had any well defined rules or instructions for the taking of samples. This is a state of affairs which cannot long continue, but it indicates a surprising lack of realization and appreciation of the importance of the subject.

It is to be hoped that the work now being done on the subject of sand testing may lead at an early date to the adoption of standard methods of test and of standard specifications.

Below are given the specifications and instructions which have been used in the laboratory of Westinghouse Church Kerr & Co., modified only in the references to the accompanying cuts.

TAKING SAMPLE IN FIELD AND SHIPPING

CONTAINER—Airtight cans having tight fitting covers or corks should be provided for shipping samples from the field to the laboratory. A wood covered or crated airtight metal can makes a very satisfactory container, which can usually be used over and over again. Avoid shipping samples of sand in bags, in cigar boxes or other wood containers, as they allow the sand to dry out before being tested.

SAMPLING BEFORE SHIPMENT—When it is practicable to keep an inspector at the sand bank at all times while shipments are being loaded, so that it may be positively known that the sand which is sampled is the sand which is shipped, then samples should be taken at the bank before loading. Or, if sand is obtained from a source which is known to produce no poor sand, has no spots or streaks of poor sand, has no overburden of loam or other objectionable material which might become mixed with the sand before it is shipped, and is in all respects a deposit from which a uniform grade of sand may be depended upon, then the samples may be taken at the bank without the maintenance of an inspector at the bank.

TAKING SAMPLE OF BANK—In sampling a bank of sand which has exposed vertical or steep sloping faces a small channel of uniform size is scooped out of the face from bottom to top. Fig. 1 shows a sample being taken in this manner. The sand scooped from this vertical channel, if more than enough to fill the container, is throughly mixed and reduced by quartering to the quantity desired. A tin dipper or can is a suitable tool with which to cut out the sample.

*Engineer of Tests, Westinghouse Church Kerr & Co., 37 Wall St., New York City.

By cutting such a groove or channel at each of the faces in the bank from which sand is obtained, samples are secured which represent with a fair degree of accuracy the sand in the bank. The samples taken from the various faces are not to be mixed together, but are marked for identification as to location and sent separately to the laboratory for examination.

If the bank contains both good and poor sand, and it is necessary to maintain an inspector at the bank to insure

CONTRACT NO. 1495 Sand to be used for { Brick Mortar / Plastering / Concrete / Floor Finish }

SAND SAMPLE SHIPPING NOTICE.
(To be mailed with express Receipt when sample is shipped.)

New York 8/13 1913
(Place and Date)

WESTINGHOUSE CHURCH KERR & CO.,
10 Bridge St., N. Y. City.

Gentlemen:—We have this day sent you by Dodds (Name of Ex. Co.) Express Co.,
a four quart sample taken from 7 (No.) loads of a lot consisting of 40 (No.) cu. yds.
Car Number L. I. 18265 (No and Initials.) Supplied by Smith Bros (Name of Dealer)
Source Cow Bay, L.I. (Exact Location of Bank)
ORDER NO. 99984

James Jones
SUPT.

FIG. 2. FACSIMILE OF SAND SHIPPING NOTICE, USED IN SAND TESTING, WESTINGHOUSE CHURCH KERR & CO.
(Actual size of card, 3x5 in.)

the shipment of good sand and to sample the sand to be shipped, then the samples may be taken from the piles or bins of sand being loaded.

TAKING SAMPLE FROM PILES AT BANK—Samples are taken with a small tin box such as a pepper or spice box, holding half a pint or less. With this small receptacle portions of sand are scooped up from many parts of the sand pile, filling the receptacle each time and emptying it into the larger can in which it is to be sent to the laboratory. The number of samples to be sent to the laboratory is very largely a matter of judgment on the part of the inspector. Whenever there is any doubt as to the quality of any shipment of sand, a separate sample should be taken of that shipment.

TAKING SAMPLE ON THE JOB—In sampling sand after its arrival on the job, the same general rules are to be followed. A small receptacle such as a glass tumbler or tin box holding not more than half a pint should be used and the can which is to be sent to the laboratory, is filled by taking sand from as many parts of the pile as is necessary to fill it. The sample should be taken from the inner part of the pile as the outer part and especially what rolls down the outside, may be composed largely of the coarser grains or pebbles.

TAKING SAMPLES AFTER DELIVERY—Samples should be taken from the shipments of sand as they arrive on the job. A preliminary inspection is to be made of the lot, whether wagon loads, car loads, barge loads, or other sort of shipment, to ascertain whether the sand appears to be all of a uniform quality and size. If the various units of the shipment seem to vary, a separate sample shall be taken of each unit and the units shall be kept separate until the sample has been examined and reported upon by the laboratory. For instance, if two carloads of sand are received, one of which is evidently finer than the other, then a separate sample shall be taken of each car, and if it is necessary to unload the cars at once they shall not be unloaded onto the same pile but shall be kept separate, provided there is any doubt in the inspector's mind as to the suitability of either sand for the work in hand. The samples shall be taken if possible during the unloading, when the shipment is in cars or barges, or from the pile after the wagon has dumped when the sand is received in wagons.

MARKING AND SHIPPING THE SAMPLE—To the can containing the sample is securely attached a shipping tag giving the name or number of the job from which the sample is shipped, the name of the dealer furnishing the sand, the quantity of sand in the shipment represented by the sample, the exact location of the bank or deposit from which the sand was shipped, and the signature of the inspector who took the sample.

The sample is then shipped by express to the laboratory for examination.

At the same time that the sample is shipped, all of the above information relative to the sample shall be sent by mail to the laboratory on the Sand Sample Shipping Notice, so that in case the tag on the ban becomes defaced or torn off, the information required will still be available. Fig. 2 shows a facsimile of such a notice properly filled out.

GENERAL CAUTIONS—The sample must truly represent the average of the entire shipment, or that part of the shipment from which it is taken.

The sample must be put into the airtight container as fast as it is taken from the pile, so that it shall not have time to lose any of its moisture.

The container must be well corked or sealed before shipment to the laboratory.

TESTING SAND IN LABORATORY

(The figures in parentheses refer to location of data on Sand Test Data Sheet shown in circles on Fig. 4.)

IDENTIFICATION OF SAMPLES—When a sample is received at the laboratory a record is made in the spaces provided in the Sand Test Data Sheet, shown in Fig. 4, of date received (1), the number of the contract (2) from which the sample as received, the name of contract (3), the name of the dealer (4) from whom the sand was purchased or who furnished the sample, and the location of the bank or source (5) of the sand from which the sample was taken. If there is any designating mark which further identifies the sample, this mark is recorded under the heading "Marked" (6).

A Laboratory Mark (7) is then assigned to the sample and this mark is placed on the can containing the sample, or on the shipping tag attached to the can, and also on the data sheet.

WEIGHING SAMPLE AND SCREENING—The sample as received, together with the container or package is first weighed carefully and the gross weight recorded (8). The entire sample is then emptied from the container in which it was received and sifted through a 4-mesh seive into a metal tray. The empty container in which the sample was received is weighed and the tare recorded (9). The gross weight of the material retained on the 4-mesh sieve (10) and the net weight of the container (11) in which it was weighed, if any, are recorded and also a brief description of this coarse material (12). This description should cover such details as color, kind of stone, whether smooth, angular, round, scaly, porous, cemented lumps, hard or soft. If this coarse material is of considerable quantity it is passed through screens having round holes ¼, ½ and ¾ inch in diameter and the amount passing each size is weighed and the net weight recorded (13, 14, 15) together with the net weight of the sample so screened (16). This coarse material is then either discarded,

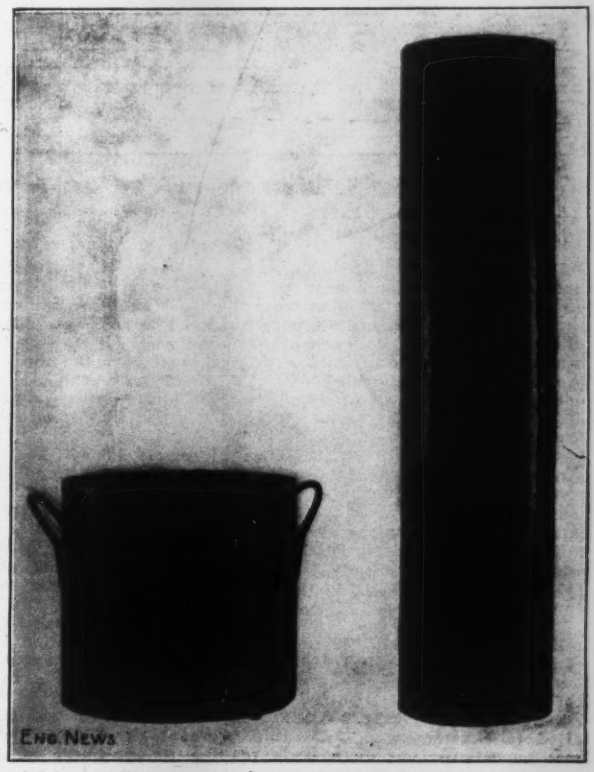


FIG. 3. CYLINDERS USED IN MEASURING SAND

or retained for further examination as coarse aggregates or gravel.

SUB-SAMPLING—The portion of the sample which has passed through the 4-mesh sieve is thoroughly mixed by hand in the metal tray, spread out in a large flat pile and a sample consisting of about 5 kg. is taken from it. The remainder of the sample is placed in an air-tight can and so stored until used. Whenever a small sample is to be taken from the main sample, care should be taken that an average sample is obtained, either by use of a sampler or by quartering down, or by spreading out in a large flat pile the entire sample, well mixed, and scooping up portions from many parts of the pile.

WEIGHT PER CUBIC FOOT—Of the sand which passed through the 4-mesh sieve, a sufficient quantity is dried at room temperature so that it is apparently free from moisture and a quarter cubic foot measure (or in case the sample is not sufficiently large, a measure of smaller capacity), whose size is recorded (17), is filled with the dry sand, by the following method. The measure used is cylindrical with a fixed bottom. Inside of the measure is placed a cylindrical tube, open at both ends. This tube has a diameter of about two-

SAND TEST DATA SHEET • • Westinghouse Church Kerr & Co., 37 Wall St., New York

| | | |

FIG. 6. PERMEABILITY TEST PIECE OF CEMENT-SAND MORTAR
(Piece as molded on left; as tested in center of right-hand view.)

net weight of the container in which it is weighed (30). The silt on the filter paper is dried at a temperature less than 212° F. and the gross dry weight is recorded (31). The weight of the filter paper is also recorded (32).

PERCENTAGE OF VOLATILE MATTER—The dried silt obtained in the "Percentage of Silt by Decantation" test is placed in a porcelain crucible and heated over a bunsen burner or blast lamp to a red heat to drive off organic and volatile matter. The silt is stirred during heating to facilitate the oxidization of carbonaceous matter. After ignition and cooling the gross weight of the crucible and contents is taken and the recorded (33) also the weight of the crucible (34).

SILT BY WET SCREENING—A sample of the damp sand is taken weighing the equivalent of 100 grams of dry sand after the proper correction is made for the moisture contained therein. This sample is placed in a 100-mesh sieve and screened wet by holding under a stream of water. After being thoroughly washed, the sand is removed from the screen, dried at room temperature, weighed, and the net weight recorded (35).

With another sample the same process is followed with a 200-mesh sieve and the net weight recorded (36).

MORTAR YIELD—A sample consisting of about 2000 c.c. is dampened, if not already sufficiently damp, so that it will hold it form when squeezed in the hand, but no excess of water can be squeezed from it.

About 20 c.c. at a time of this sand is tamped into a cylindrical metal container about 1½ in. in diam. and 15 in. tall, until exactly 100 parts are well tamped in. This metal cylinder is provided with a cylindrical metal tamper about 1 in. in diameter, graduated on the outside so as to show the quantity of material in the outer cylinder. The capacity of this metal graduate is such that 100 parts on the scale is a little more than enough to make two 2-in. cubes, the volume being 270 c.c. This cylinder and graduated tamper are shown in Fig. 5.

This sand is emptied out of the graduate and all sand sticking to the sides of the graduate and to the tamper is cleaned off. To this sample of sand is added 50 parts of cement. The cement used is, if possible, of the same brand as will be used with the sand on the job; or if not, then a composite sample of several brands is used. The laboratory mark of the cement used is recorded (37). This cement is weighed, and the weight taken is based on the assumption that 95 lb. of cement has a volume of one cubic foot, on which assumption 100 c.c. of cement will weight 0.3360 lb. or 152.4 grams and 50 parts in the graduated cylinder, or 135 c.c. will weigh 0.454 lb. or 206 grams. The cement and sand are well mixed by kneading by hand, and sufficient water is added to bring the mortar to a quaking consistency. The mortar is again all tamped into the graduate, about 10 parts at a time, and the resulting volume of the mixture is recorded on the report form. This shows the increase in volume of a 1:2 mixture over the volume of the sand under test. By adding 40 parts of cement to another 100 parts of sand the increase or change in volume of a 1:2½ mixture is obtained, and by adding 33⅓ parts, 28½ parts, 25 parts and 20 parts to other sample consisting of 100 parts of sand, the changes in volume of 1:3, 1:3½, 1:4 and 1:5 mixes respectively are ascertained and recorded (38). The date of making this test is also recorded (39).

For convenience in measuring the cement accurately, the accompanying table is prepared, giving the weight in grams, and in pounds avoirdupois of the quantity of cement required to mix with 100 parts of sand to produce proportions

TABLE OF WEIGHTS OF CEMENT FOR MORTAR YIELD TEST

Proportions cement to sand by volume	Cement parts by volume	Cement weight grams	Cement weight lb. avoir.
1—1	100	412	0.908
1—1¼	80	329.6	0.726
1—1⅓	66.7	274.6	0.605
1—1½	57.1	235.4	0.518
1—2	50	206	0.454
1—2¼	44.5	183	0.4045
1—2½	40	164.8	0.363
1—2⅔	36.4	150	0.330
1—3	33.3	137.3	0.3025
1—3¼	30.8	126.8	0.2795
1—3½	28.5	117.7	0.259
1—3¾	26.7	109.8	0.2422
1—4	25	103	0.227
1—4½	22.2	91.5	0.2023
1—5	20	82.4	0.1815
1—5½	18.2	75	0.165
1—6	16.7	68.7	0.1513

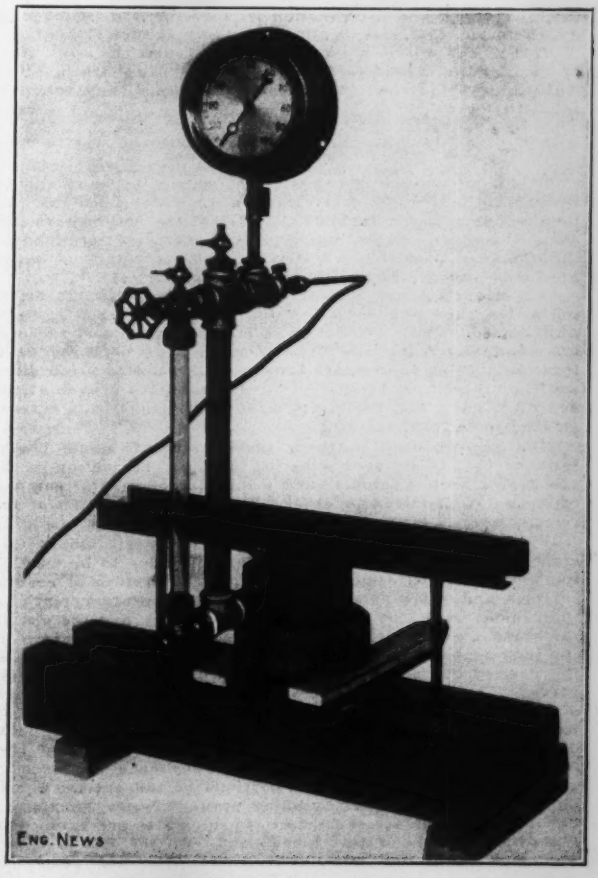


FIG. 7. RECORDING APPARATUS OF PERMEABILITY TEST

varying from 1:1 to 1:6, assuming that 95 lb. of cement has a volume of one cubic foot, and that 100 parts in the graduated cylinder are equal to 270 c.c.

COMPRESSIVE STRENGTH—The mortar from the "Mortar Yield" test is removed from the graduate and two 2-in. cubes are molded with it so that each mixture is made up into two 2-in. cube specimens for further test. The cubes are stored in the molds for 24 hours in a damp closet, then removed from the molds and stored thereafter in water. At the end of 7 days one cube of each mixture is taken from the water, faced with a very thin layer of plaster of paris on plate glass on two opposite sides of the cube which were exposed to the surface of the mold in making, and crushed in a compression machine. The total load required for crushing is recorded (40). At the age of 28 days the second cube is crushed in a similar manner and the total crushing load recorded (41).

SPECIFIC WEIGHT—At the end of 14 days the remaining 2-in. cube of each mixture from the "Compressive Strength" test, is removed from the water, wiped off and weighed and the net weight recorded (42). It is then immediately weighed while suspended immersed in water at the temperature of the room and the net immersed weight is recorded (43).

DRY WEIGHT—Each cube used in the "Specific Weight" test is placed in a hot oven at a temperature of less than 212° F. and dried to constant weight. At the age of 21 days after making it is weighed while dry and its net weight recorded (44). The cubes are then returned to the water bath and kept stored until 28 days old and are then used for the 28-day compression test as described above.

TENSILE STRENGTH—Nine briquettes are made of standard Ottawa sand and portland cement mixed in the proportion of one part of cement to three parts of sand by weight, in the manner prescribed for standard tests of portland cement by the American Society of Civil Engineers. The percentage that the gaging water bears to the total weight of sand and cement (in this case 3 lb. or 1361 grams) is recorded (45). Nine more briquettes are made of the sand under test mixed with the same proportions by weight with the same portland cement as was used with the standard sand. The sand under test is used damp, just as it comes to the laboratory, and a correction is, therefore, to be made in weighing out the sand to allow for the moisture present.

Three quarters of a pound of cement and the equivalent of two and one quarter pounds of dry sand are used to make nine briquettes. The amount of damp sand taken is equal to

$$\frac{2.25}{1 - \text{per cent. of moisture in sand}}$$

This damp sand is mixed with the cement by hand and by trowel, until of a uniform color before water is added, and then enough water is added to bring the mixture to the same consistency as the standard sand mortar determined by the Chapman Consistency Method.* The percentage of water used is recorded (46) and the date of making (47).

All briquettes are stored in a damp closet for 24 hr. in the molds, then removed from the molds and stored in water until tested. Three briquettes of standard sand and three of the sand under test are broken at the age of three days, three briquettes of each are broken at the end of seven days, and the other three briquettes of each sand are broken at the age of 28 days, and the strength of each briquette is entered on the report form (48).

The cement used in these tensile strength tests is the same as that to be used with the sand on the job, or in the absence of such a sample then a mixture of several samples of cement well mixed together. The laboratory mark of the cement used is also recorded (49).

PERMEABILITY—Mortar or concrete test blocks are made up, preferably with the cement and stone to be used on the job, or with a cement consisting of a mixture of several samples and some suitable stone. The laboratory mark of the cement used (50) and the stone used (51) and the size of the stone are recorded (52). Mixtures are made up which, in the judgment of the operator, will give mortar or concrete of the desired characteristics and the proportions used are recorded (53). The date of the making of the specimens is also recorded (54) and the dimensions of the specimens (55), for which two sizes are used, one 2-in. thick and 3½ in. in diameter and one 2 in. thick and 12 in. in diameter of surface exposed to the water pressure. Specimens are made up in a mold to such form that portions of the specimen may be broken off before testing under pressure so as to expose a newly broken surface of concrete to the water pressure. Fig. 6 shows the form of test block used. On the left is shown the block as molded and on the right, after the projecting portions have been broken off and the specimen is ready for test.

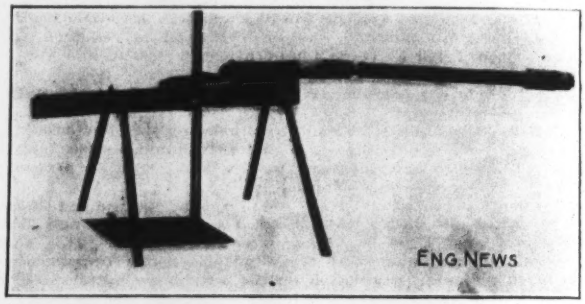
Specimens are stored for 24 hr. in a damp cl[oset], then the molds are removed and they are stored in damp [sand] until tested. At the end of 14 days the specimens are [placed] in the pressure-testing outfit and water pressure [is] maintained by means of an air-presure tank, the pr[essure] in pounds per square inch is recorded (56). Date of [testing] is also recorded (57). The time when the water pr[essure] is applied is recorded (58). The reading of the w[ater] level in the graduated gage glass of the apparatus at the [start] is recorded (59), also the readings at the end of 5, [10], 15, 20, 30 and 45 minutes and 1, 1½, 2, 3, 4 and 6 hours, after the pressure is applied, are taken and recorded (60). If the permeability is such that the water is lowered in the graduated gage of the apparatus to a point near the limit of the graduation, the readings before and after adding water are both recorded. Fig. 7 shows the apparatus used in this test.

*Engineering News, July 3, 1913, p. 42.

An Attachment to Automobiles for Quickly Closing Large Water Valves

The quick closing of large water-supply valves in time of emergency, as when a main bursts, is of great importance but where reliance is placed on closing by hand as much as an hour and a half is consumed in closing a 48-in. gate valve. To overcome this, an attachment has been devised whereby power for operating the valve is furnished by any automobile of sufficient rating—about 20 hp.

This attachment consists of four parts. A four-legged support, on which is a set of bevel gears, is placed over



THE AUTOMOBILE ATTACHMENT IN OPERATING POSITION

the valve to be operated (see the view). Keyed to the center of the driven gear is the valve key.

A wheel attachment made to fit any diameter of automobile wheel, consisting of four curved radial, hinged arms and a handwheel tightening device, is connected to the driving gear on the support by means of a slip-shaft. The slip-shaft is fastened to the gear and automobile-wheel device by means of two toggle joints. The toggle joints and the slip-shaft compensate, respectively, for the difference in elevation and the distance between the car and the gears. The rear wheel, which furnishes the power, is, of course, jacked up. The accompanying view does not show the wheel attachment.

This apparatus was recently demonstrated before several members of the Trenton, N. J., Water-Works Department. The test was made on a 12-in. valve at Prospect St. and Pennington Ave. The test appliance was made of pieces of scrap-steel aggregating about 200 lb. W. H. Van Winkle, president and manager of the Water-Works Equipment Co., 50 Church St., New York City, the inventor, estimates that the perfected device will not exceed 125 lb. in weight.

Editorials

The maxim, "Be Sure You're Right, Then Go Ahead," is particularly applicable to the engineer, only it might well be changed to run, "Be Sure You're Right before You Go Ahead." A good example of the practical application of this maxim was afforded recently by the city of Akron, Ohio, which, on the recommendation of an engineer, decided to spend the modest sum of $10,000 on sewage-treatment experiments or tests before it began the design of works to treat the sewage of the whole city. An abstract of the interesting report made on these tests is given elsewhere in this issue. In building and operating its sewage-testing stations, Akron followed the example of a number of other cities, the first of which was Columbus, Ohio.

It might be thought that after the thirty years or so of experimentation with sewage treatment at Lawrence, Mass., the shorter but still lengthy series of tests carried out by the Massachusetts Institute of Technology and the tests made by a number of cities it would be quite unnecessary for Akron to conduct tests of its own. This is far from being right. The sewage of each city presents problems peculiar to itself, particularly where trade wastes enter into account to any considerable extent. At Akron, it was thought that the trade waste from rubber works, a paper mill and the salt industries would materially interfere with sewage-treatment works. The experiments showed that this need not be feared. They also gave information of use in deciding what sort of a sewage-treatment plant to adopt and how it could best be operated after it was built.

In our issue of Nov. 20, we criticized an advertisement published in some of the November magazines relating to a correspondence course of instruction called the Emerson Institute of Efficiency. Our criticism referred to the advertisement alone, and was not intended to refer to the Institute itself, which we have since learned is under the auspices of the publishers of the *Review of Reviews,* which should in itself be a guarantee of honesty and good faith in its conduct.

Our criticism of the advertisement was because the reader might conclude from it that the course of training given in the correspondence course of 24 lessons was sufficient to enable one who had taken it to earn such high salaries in efficiency work as were stated in the advertisement to be commanded by efficiency experts of experience.

A further investigation of the purposes and claims of those who are in charge of the Institute has made it clear that it is not their intention to claim that they can graduate full-fledged Efficiency Engineers. They call their lessons "A Home Study Course in Personal Efficiency." The lessons are designed to convey to the student taking the course the essential elements and principles upon which efficiency may be acquired by any intelligent person in the conduct of any work small or great, from that of the home or the school to the carrying on of a business or profession, and to furnish to those of requisite ability and experience a definite groundwork for a career as an efficient business man. Such instruction may be helpful to men and women in all walks of life and it is farthest from our intention to criticize or discourage it.

Engineer-Commissioners or Commission Engineers?

A brief report was made in our issue of Jan. 16, of the remarks of several prominent engineers at a meeting of Stevens Institute Alumni and others, called to discuss the part of engineers in public-utility regulation. There was not, contrary to our expectations, complete harmony of views as to the advisability of putting engineers on such commissions, and the dissenters were such prominent men as Newcomb Carlton, of the Western Union Telegraph Co., and George Gibbs, of the Pennsylvania R.R. Our readers are familiar with the affirmative arguments on this question, so that it is not necessary to dwell on them. The doubters seem to feel that the administrative work of a commissioner would interfere with his knowledge of engineering progress to such an extent that in time he might make a decision on false technical grounds.

This meeting and these arguments recall to us that there are seemingly three states of mind which each one progressively reaches in considering this question. The first is a quick and more or less enthusiastic acceptance of a proposition attractive on its face; the second stage is one in which serious doubts begin to rise about details and secondary effects; the third, and generally the final, mental attitude comes when time is taken to study the troublesome points at length, to see if they can be eliminated or if the benefit will not outweigh the chances of harm. Apparently the eminent skeptics in this instance have arrived at the second stage only, and it is probable that if they could secure sufficient time to pursue the subject they would quickly dismiss their doubts. We feel that this is so, first because the evidence seems overwhelming that the advantages of engineer-commissioners outweigh the possible disadvantages; in the second place, the advantages are sure and the disadvantages are only mere possibilities at worst.

As to the one specific objection which we have mentioned, it would seem that a commission composed of lawyers, business men and engineers could arrange its work so that the engineers would not be so wholly lost in administrative detail that their profession would leave them behind; especially would this seem unnecessary if the commission were warned in advance of this rock in its course.

From Mr. Sague's experiences on the New York Commission, Second District, as related in a paper which we reprinted last week, it is evident that he is no less of a railway engineer than in 1907, when he became a commissioner.

The Ohio Conservancy Bill

The Ohio floods of 1913 have led to the introduction in the Ohio legislature of "A Bill to prevent floods, to protect cities, villages, farms and highways from inundation, and to authorize the organization of drainage and conservation districts." The features of the bill of most interest to engineers are outlined elsewhere in this issue. Briefly, the bill provides for the organization of conservancy districts, administered by three directors with powers to do almost anything with the waters within the district which can be shown to the satisfaction of the courts to "be conducive to the public health, safety, convenience or welfare." The act is broad enough to permit the initiative to be taken by almost anybody, from two or more property-owners to a city or county, and once a district is formed and directors appointed, the directors have almost unlimited powers to formulate, adopt, execute and finance an "official plan."

The powers conferred by the bill seem well calculated to meet the flood-prevention needs of Ohio and to promote in many respects both water conservation and utilization. But the bill would perhaps have been better had it made some provision for taking natural drainage areas into account and it might well have contained somewhat different references to the engineer as an essential agent in carrying out its provisions. The bill seems to ignore some principles of representative government and administrative efficiency, for it vests large powers of planning, execution and taxation in three men appointed by a minor court, with no prescribed qualifications for fitness and no adequate control as regards either efficiency or integrity. In addition, the proposed conservancy districts may give rise to administrative confusion, to say the least, since they are to be independent political divisions of the state and may overlap in area and function the existing civil divisions.

Presumably some, if not all, of these limitations were considered by the framers of the bill and waived in order to meet the need for easily and quickly created and readily worked machinery to meet the exigencies of the situation. It seems as though these exigencies might have been fairly well met without so much sacrifice had the governmental aspects of the subject been considered in the light of accumulated experience and knowledge.

Over-Confidence in Concrete

During the coming two weeks a great number of contractors and engineers interested in concrete will gather in Chicago to view the annual Cement Show and to attend the numerous conferences and conventions devoted to cement and concrete subjects. They will inspect the latest appliances and devices and will listen to committee reports, papers and discussions, all intended to raise the standard of design and construction and to improve the individual and collective practice in concrete work. Undoubtedly all of this will have a most desirable result, and those who attend will go home just a little wiser and will impart to their less fortunate co-workers some of the surplus knowedge they have obtained.

In all of the proceedings and inspections, however, we venture to say that little mention will be made of one condition, the proper appreciation of which would do more to raise the standard of concrete construction than all of the efforts put forth at the Chicago [illegible]. *Practically every failure and near failure in concrete has been due to confidence on the part of somebody that concrete can surmount all manner of bad usage.*

It is a stock statement in explanation of [illegible] trouble or an excuse for lack of definite standard[illegible] that concrete design and construction is in a state of [illegible] and that standards of today may well be obsolete tomorrow. This explanation had a certain reasonableness during the past fifteen years when reinforced concrete was coming into its own, but fifteen years of practice go a long way toward that perfection everyone is seeking and the infant-industry excuse can no longer be tolerated. The fact is that there are plenty of good standards in concrete design and in concrete construction but that they are not observed by many of those engaged in concrete building.

This neglect has a three-fold cause; ignorance, undue economy and over-confidence—and the first two could not exist were it not for the last. It is a pretty poor concrete man who does not know that frozen concrete will not set—but there are plenty who will take a chance with 10-day concrete at 40° F. if they need the forms. Why? Primarily because they want to save the money that an additional set of forms would cost. But if there were not confidence that the concrete will stand up, the pocketbook would not govern judgment.

Practically every designer of concrete buildings will admit that 850 lb. per sq.in. is too high a stress in the concrete beams over the room where his own family sits down to dinner, but he is not so worried about that stress when it is in someone's garage. He feels confident that it will not fall down, in spite of tests which show it to have a low safety factor. Any man who cares to take the trouble to investigate the question will seriously doubt the final strength of supersaturated concrete slushed down a chute, but chuting is economical and the chances are the concrete will stand up. These testing engineers and office men are "Miss Nancies," anyhow, who don't know anything about practical work!

Throughout the whole field this pernicious combination of ignorance and complacency extends; instances might be multiplied almost without end. It is the duty of the societies such as the American Concrete Institute, which meets next week in Chicago, to urge upon the workers in the industry a proper appreciation of the dangers of this over-confidence. Ignorance can be combated—in time the densest mind can be penetrated. Skinning of work is a species of ignorance, for nothing is quite so evident as the fact that good work in concrete construction pays; even the most impecunious of men will sooner or later find this out. But the man who thinks he knows more than the so called authorities is the hardest to reach because he is clad in the nearly impenetrable armor of conceit.

Every concrete failure means a slight betterment in methods, for a certain number of hitherto unconvinced practical or commercial men are shown by that most potent object lesson, a heap of ruins, just what concrete will *not* stand. But since a concrete failure cannot be provided for the instruction of every over-bold designer or constructor the only other means of raising and stabilizing the standards of concrete—or rather of insuring the adoption of those quite sufficient standards already available—is the admirable work done by the societies, the continuous publicity in the technical press and the

steady effort on the part of engineers to improve the building laws of our cities so as to secure in those centers where most of the poor concrete work is done an official recognition of what is good concrete design and construction.

Another Bridge Engineering Competition

Many of the readers of ENGINEERING NEWS will recall our criticisms in our issue of May 29 last with reference to the advertisement for competitive designs for a reinforced-concrete bridge at Richmond, Va. We have been informed that the discussion of that competition in these columns prevented similar action which had been contemplated in some other cities and the substitution of a wiser method of selecting an engineer for the work.

A correspondent now calls our attention to a new bridge competition, this time at Chattanooga, Tenn., where a bond issue of $500,000 has been voted by Hamilton County to build a bridge across the Tennessee River. A "Bridge Committee" has been appointed to take charge of the work and has published an advertisement inviting bridge engineers to submit competitive designs and estimates. The advertisement states that on Feb. 18 these designs and estimates will be judged by the Bridge Committee and the contract for design and supervision will be awarded.

The design adopted must meet the approval of the U. S. War Department, but no information is given competitors as to what restrictions the Department is likely to impose upon a bridge at this site, or whether Congressional legislation has been obtained permitting such a bridge. Further than this, the Committee has informed a would-be competitor that it can furnish no maps or profiles of the proposed site and apparently it has made no surveys.

If its advertisement is to be taken in good faith, then, it evidently expects that any engineer proposing to compete will himself go to the expense of making surveys. soundings and borings on the proposed site for the bridge, and will do this merely on the chance that his design may be the one selected and that he may be able to make a satisfactory bargain for proper compensation.

It will be noted that no prizes at all are offered. The Bridge Committee merely wants to build a bridge at a certain point and expects that reputable bridge engineers of such experience and standing as to be competent to undertake such a structure will come forward in considerable numbers and offer them complete designs for the bridge from which the committee can make its selection!

We do not see how any engineer, unless he is a resident of the immediate locality, can possibly afford the gambling risk of offering a design of any sort in such a competition. Unless an engineer has information as to the local conditions with respect to foundations, etc., he would have to work in the dark in making any design.

Possibly some engineer resident in the vicinity, with some knowledge of the conditions at the bridge site and with no expense involved for traveling, etc., may be able to offer some general drawing in the competition. But if the Bridge Committee wished to restrict its competition to engineers and contractors in the locality, why did it publicly advertise for designs?

Reading between the lines of the Committee's offer, it appears probable that what it has in mind is really the service of bridge-building companies rather than of professional engineers. The members of the Bridge Committee, in other words, are proposing to apply the methods usual in letting contracts for little highway bridges to the construction of a half million dollar bridge. It expects the bridge-building companies, who are used to taking gambling risks of this sort, will come forward on Feb. 18 with various ornamental designs for the proposed bridge, from which the committee will proceed to make its selection, aided by the expert advice of the respective bridge salesmen!

It is almost needless for us to explain in the columns of ENGINEERING NEWS the evils of the ordinary plan of letting highway-bridge contracts, the graft and incompetence and bad engineering work prevalent in this field have been so often laid bare. Nor does it seem necessary to point out in detail how great is the injury to the engineering profession if important engineering work is to be carried out in the way proposed at Chattanooga. It does seem worth while, however, to point out why the Tennessee River Bridge Committee is not merely doing serious injury to the engineering profession, but is falling far short of its duty to the taxpayers who have delegated to it the responsibility for this important structure.

In the first place the design to be selected for the site will be influenced very largely by foundation and other local conditions. Until these are determined by careful and reliable surveys, no engineer can make a design for the site without running the risk that the design might be seriously defective.

The problem before the committee and its engineer is to provide for the site either the best bridge that can be erected with a given amount of money, or a bridge that will furnish the necessary service and offer the best artistic appearance for the least money. In either case no solution of this problem can be made until accurate knowledge of the site is obtained. Such surveys must be made sooner or later anyway, and will cost no more if made at one time than at another.

The Committee may possibly have the idea that by postponing these surveys until an engineer is engaged and the contract is let they will save their cost to the taxpayers; but the veriest child should realize that even if the contractor for the bridge should undertake this work, he will add its cost to his contract price. Rather he will do even more than this, by adding enough to the contract price to cover the cost of the surveys under the most difficult conditions.

This, however, is by no means the worst of the situation. The Committee has no business to delegate such work to the contractor for the bridge. The Committee has no greater responsibility upon it than to see that the structure it erects is first of all safe; and it can by no means afford to leave the determination of foundation conditions to a contractor, but should have them ascertained by its own engineering staff, with full authority to see to it that the foundation conditions are thoroughly explored and safe foundations are secured regardless of any commercial consideration.

In nothing is the ignorance of the committee revealed more clearly than in its statement that it will receive competitive designs and *estimates*, and that the contract for design and supervision will be judged by the commit-

tee on the basis of these *competitive* designs and *estimates*. In other words, the committee proposes to select an engineer to whom it can delegate the responsibility for this structure, not on the basis of his previous experience, his professional standing and ability, as shown by the statements of those engineers and business men who can best testify as to his competence to handle a work of such a sort; but it proposes to select the engineer who offers the most satisfactory picture of the proposed bridge and the most attractive *guess* as to the cost of its construction. The premium on "guessing low" is so obvious that it needs no comment.

The idea that *competitive estimates* could be prepared for a bridge upon a site where no surveys have been made and no knowledge of the foundation conditions exists, appears preposterous to every engineer, and its absurdity ought to be clear even to any intelligent business man. It would be about as reasonable to ask lawyers to submit competitive plans and estimates for conducting a lawsuit, or to ask physicians to submit competitive plans and estimates for treating a case of typhoid fever.

It is perfectly clear that such methods of selecting and employing engineers as are proposed at Chattanooga tend to drive out of business the engineer who is seeking to make a living by independent consulting practice, and to throw all bridge construction solely into the hands of contracting companies. Such a change would be not only a most serious blow to the engineering profession, but to the public welfare. Even this Tennessee River Bridge Committee realizes that an engineer is needed to design the structure and to supervise its erection by the contractor. It is altogether probable that its blunders have been made solely through ignorance of the right way to go about the task of selecting an engineer for this work.

And this raises the question whether, after all, the responsibility does not come back to the engineer or to the engineering profession. The correspondent whose letter is before us writes: "Cannot something be done to save engineers all this expense at such a season as this?" His inquiry is a very pertinent one. Whose business should it be to see to it that public bodies like this, having the task of selecting an engineer, should have information given them as to the right way in which to undertake such a task?

The individual engineer, without doubt, is helpless to remedy matters; but surely the representative organizations of the profession should be able to find a way whereby to enlighten members of such public commissions as to the proper method of procedure to protect the interest of the taxpayers whom they represent.

Of course, if this Chattanooga bridge competition were an isolated example, it may be said that such action would not be worth while, but while some of the conditions at Chattanooga are aggravated, the general conditions there unfortunately, are only too typical.

Engineers in the higher ranks of the profession as well as the lower are obliged by the stress of competition to follow methods in obtaining business that are not at all in accordance with proper professional standards. We could cite a multitude of instances; but the one that stands out vividly in the minds of engineers and ought not to be forgotten by the public is the Quebec Bridge disaster, where a man whom all engineers honored for his ability and achievement attempted to do the engineering work for a pittance so small that thorough supervision was an impossibility.

We believe the Committee of the American Society of Civil Engineers appointed to investigate the conditions of employment and the compensation received by engineers has an opportunity for valuable work in studying the conditions under which engineering work is given out and the changes that need to be made in the interest of the profession and of the public.

We would not be misunderstood as advocating the elimination of competition among engineers. Such a task would be attempting the impossible. On the other hand, with competition conducted as it now too often is, its results are detrimental both to the profession and to the public. The direct tendency is to throw work into the hands of concerns with the lowest professional standards or none at all, who often combine the functions of the engineer and the contractor. Men of greater ability and higher standards of honesty are driven into some other occupation; and such an outcome is nothing short of a public calamity.

The public needs the best men in the engineering profession; not only men of ability who can keep our standards of engineering work apace with those of every other nation, but men of such high moral and professional standards that they can be trusted to carry out work with entire honesty and to protect the interests of the taxpaying public. The limitation and regulation of competition tends to benefit the public by keeping in the business a large number of active, energetic and competent men. Unregulated competition, on the other hand, conducted in the manner which at present too often obtains, tends to the survival of the unfit and to the creation of monopoly.

Letters to the Editor

A Teredo-Proof Wood (?)

Sir—In your issue of Jan. 15, an item was published relating to the Australian turpentine tree (syncarpia laurifolia) under the caption "A Teredo-Proof Wood." Reference was therein made to an article in the "Commonwealth Engineer," which I have not been able to obtain. However, the Forest Service has recently collected a considerable quantity of data relative to all of the woods used for piling in all portions of the world. The following remarks, therefore, may be of interest to you in connection with the item above mentioned.

The turpentine tree of New South Wales is considered by the authorities of that colony as the only timber they dare drive, unsheathed, in shipworm-infested waters. They specify, however, that all piles of this species must

be driven with the bark on. But Messrs. Maiden and De Coque, who were authorized by the New South Wales Government to investigate the properties and uses of the turpentine tree, concluded that this timber, barked or unbarked, is not absolutely proof against the marine wood borers.

After observing the logging, transportation and driving of turpentine-wood piles they recommended that their future use should be discontinued unless thoroughly sheathed, except in pure salt water, in which, under Australian conditions, the marine wood borers are apparently not active, and in foul salt water, where the organisms cannot exist. The reason for this recommendation was that the bark could scarcely ever be kept intact, no matter what precautions were observed. The necessity for keeping the bark intact is recognized not only in New South Wales, but in New Zealand and Japan.

It may be said that, in many cases, turpentine-wood piles have given long and satisfactory service, but most particularly in New South Wales waters, where the nausitoria (and not the teredo) genus are causes of destruction. In other places the use of turpentine-wood piles has not, in many instances, been satisfactory.

There are many objections to the use of this species. In long sticks it will not give a top diameter approaching that of Douglas fir; it is almost too brittle to be used for fender piling; it must, on account of its high specific gravity, be floated on scows before driving; and, on the whole, it requires more careful handling than the species employed for piling in this country. It seems to be highly available in New South Wales, where it is the cheapest commercial hardwood; but, because of the objections above mentioned, it is likely to be expensive elsewhere.

The main point to be considered is that it is not proof against the marine wood borers, in which respect it may be classed with the 210 other piling timbers upon which the Forest Service has collected information.

HOWARD F. WEISS,
Director, Forest Products Laboratory (U. S. Dept. of Agriculture).

Madison, Wis., Jan. 22, 1914.

The Compensation of Engineers

Sir—The writer (who is not a member of the American Society of Civil Engineers) finds it hard to entirely agree with your editorial concerning "The Compensation of Engineers," in your issue of Jan. 22. An experience of over 30 years, covering the earnings of members of his staff, together with those of his professional associates, inclines him to believe that the deductions are fairly accurate up to the eleventh year, but are too low for later years.

It is probable that little of real value can be learned until those reporting are divided into two classes, one of which shall include those who are really in responsible positions, or in private practice, while the other will include men who are occupying positions lower than that of assistant engineer. I do not know how large a percentage of the latter class may figure in the returns collected by the Committee, but the results would indicate that it must be considerable. There is, I believe, no reason to conclude that an average engineer of the former class, within or without the Society, does not reach higher rewards than those given in the diagram on p. 166 of your last issue, as the average beyond the eleventh year.

As to the responsibility resting upon the Society to better the conditions of employment and the compensation of civil engineers, there can be no difference of opinion, especially if its members are obtaining no better compensation than is indicated by the returns. This subject is intimately related to that dealt with in your other editorial, entitled, "A Proper Plan for Promoting Publicity."

We need not waste sympathy with "The chronic complaint by engineers that their work is not properly appreciated and understood by the general public." If there is any foundation for it, then you are entirely right in saying that the profession should rely upon its own exertions to remedy this condition. Probably at no period has the public been more ready to give proper recognition to the profession than at present; and if such recognition is not had, we must conclude that the engineer himself is at fault.

Furthermore, any concerted effort which aims too directly at increasing compensation is unworthy of the profession, and will fail. The only way to permanently command public appreciation and respect is to merit it; and this means to raise the ethical standards of the profession to somewhere near the point attained by the medical and legal professions. If the Society permits its members to bid against fellow engineers for work, or countenances active endeavors to supplant professional brethren in good standing, either in public or private employment, it has no reason to expect from the public much respect for the profession.

Some other bad practices are accepting preliminary work at absurdly low compensation, with a hope of recouping later; patenting engineering designs which in some cases have originated entirely with others, or at best are merely evolutions from current engineering practice, and discussing engineering papers in a partisan spirit, without reading them, or by reading into them something which they do not contain.

If these practices exist among the members of the Society, then whenever the Society shows that it seriously intends to correct them, many engineers who are not now members will feel it their duty and privilege to join it and assist in raising the standards of the profession.

It is, furthermore, extremely important that engineers shall take an active part in civic betterment. From the nature of their public employment they often have knowledge of extravagant or inefficient administration of public affairs and how it may be cured, and thereby have become charged with a heavy responsibility to the public. It must be left to the Society to judge whether or not, during the active campaigns of the last few years, for better results in City and State government it has duly fulfilled this obligation.

The engineer who does not observe those reasonable ethical standards which dignify professions, and who does not properly fulfill his civic obligations, has no right to complain of a lack of public recognition. He is probably already getting more than he deserves.

"CITIZEN ENGINEER."

New York, Jan. 26, 1914.

Why Plate Girders Were Used on the Approaches to the Hell Gate Arch

Sir—It is not surprising that for the approaches to Hell Gate Bridge, masonry arches in place of steel-plate girder spans should have been suggested by your correspondent on "The Esthetics of the Hell Gate Bridge," in your issue of Jan. 22.

To almost any designer, masonry arches would have occurred as the first choice. Masonry arches require no painting and when built of concrete are sometimes not more expensive than steel-plate girders; but the weight of a masonry-arch viaduct, particularly of a high viaduct, is very much greater and requires good foundations.

Such foundations could not be secured at any reasonable cost either on the Long Island end or the Bronx end of the viaduct, the length of which, including the bridges over three estuaries, is about three miles. On the Long Island side the ground is a moraine formation consisting of layers of sand, boulders, gravel and loam, underlaid in many places with pockets of quicksand and clay, saturated with water. This underlying water-bearing material is above tide level and liable to be drained in the future.

The foundations for the abutments of the 1000-ft. arch are on rock, but on the Long Island side the underlying rock drops away as one goes from the river to a great depth which could not be reached without prohibitive cost. The foundations of the viaduct piers had, therefore, to be placed in the upper crust of the ground at a depth of 12 to 25 ft. below the surface and the bases of the piers were made very wide, because the safe bearing value of the ground was frequently not over 2½ tons per sq.ft. For a time it was even a question whether a lighter construction of steel columns might not have to be used instead of the more substantial and durable concrete piers.

Slight settlements in these pier foundations may occur in the future when the territory becomes built up and when the completed sewerage system of the neighborhood may drain the lower strata. With a plate-girder superstructure, settlement of the piers, should it occur, is of no consequence and can easily be adjusted, but this is not the case with masonry arches, particularly of concrete, in which (even when reinforced) cracks would surely occur.

It is true that on some parts of Ward's Island and Randall's Island, rock foundations are close to the surface; but it would not do to have several different types of viaduct construction, masonry arches mixed with plate-girders for about 120 spans in this long structure. Plate-girder construction (having the same depth of girders throughout) on concrete piers was, therefore, chosen as the type that could be uniformly carried out for the entire series of some 120 spans.

As regards the objection to the deteriorating and nerve-racking noise from trains passing over a plate-girder structure, it may be well to repeat here that the four tracks on the entire viaduct will be embedded in broken-stone ballast 14 in. deep (the same as on embankments or in cuts) for the express purpose of deadening the noise. This stone ballast will be carried in troughs of reinforced concrete, thus forming a very massive track foundation that will effectively absorb the rattle of passing trains. The stone-ballasted tracks will extend also across the Hell Gate Arch Bridge.

As the motive-power on this railroad will be electricity for all trains both passenger and freight, there will be no nuisance from cinders or from puffing locomotives.

As regards the granite towers for the Arch Bridge, it should be explained that they are necessary parts of the structure, and not mere ornamental parts, as some may suppose. Both abutments are founded on rock, that on Ward's Island being at considerable depth. To save in width and cost of foundations, it was needful to steepen the resultant from (the horizontal component of) the thrust of the arch with (the vertical component of) its load. That required a certain weight in the abutment above the springing line of the steel arch. A mass of masonry reaching up to the track level might have furnished that weight, but would have been unsightly. The same weight arranged in the form of a hollow tower gives a better solution, and besides provides necessary room for stairways and other purposes.

The genesis of the steel-arch type, which has been criticized by others, also grew in this case out of local conditions. A curve in the tracks at the western or Ward's Island end commencing near the bridge, excluded a cantilever or other symmetrical three-span structure and narrowed the choice down to a single span, which could be erected without falsework in the river.

The River Boulevard on the Long Island side fixed directly the position of one abutment and indirectly also that of the other abutment. The height and width required by the Government for navigation fixed the intersection of the arch with the roadway.

To avoid tension stresses in the lower main member, the depth of the arch rib at the quarters is a little more than one-fourth the rise of the arch. That fixed the depth of the rib, which decreases toward the crown, to reduce temperature stresses.

The upper arch member is curved slightly upward at the ends, to permit of stout portals for carrying the wind stresses from the upper chords down to the arch footings.

The upper arch members extend into the stone towers and are provided with handrailings (not visible in the view of the bridge published by you), so that the steel structure will be easily accessible for inspection. And so on throughout the design the engineering and utility features governed the architectural features. Even in the method of erection, economy is the watchword, since the heavy temporary anchorages will be largely composed of plate-girders to be later used for the viaduct approaches, and will require little extra material.

It should also be mentioned, that on both sides the neighborhood of the arch bridge will be parked, which will insure to the structure permanently beautiful surroundings.

GUSTAV LINDENTHAL.
68 William St., New York, Jan. 26, 1914.

The Standardization of Cement Sieves

Sir—The Bureau of Standards is endeavoring to bring about greater uniformity in the fineness determinations of portland cement as ordinarily made on standard 200-mesh sieves.

To this end the inclosed circular letter has been sent to all who are known to possess sieves standardized by this Bureau. As the owners of these sieves are in many cases unknown to us, we are asking your coöperation in bringing this matter to their attention through your columns, in order that they may take advantage of this offer and aid us in acquiring the necessary data.

S. W. STRATTON,
Director, Bureau of Standards.

Washington, D. C., Jan. 28, 1914.

[The inclosure follows:—ED.]

In view of the considerable discrepancies which are known to exist in the sieving values of standard 200-mesh sieves as obtained in the sieving of portland cement the Bureau of Standards has recognized the necessity of supplementing the measurements heretofore made on the sieve cloth by actual sieving tests.

Thus an approximate "correction" will be determined for each sieve by means of which its actual sieving value can be reduced to some definite standard.

Prior to the adoption of this plan, however, the Bureau asks your coöperation and assistance in determining a standard, and offers you an opportunity to determine the corrections to your own sieves without payment of fee. If you will send us the B. S. numbers of the standard 200-mesh sieves in your possession, a sample of carefully mixed cement, sufficient for three tests on each sieve will be sent you. As the determination of the standard will be based on all the results obtained, you are requested to send us the results of your individual sieving tests together with the number of the sieve upon which determined, as soon as possible after receiving the samples.

It is suggested that your most careful and experienced operator perform all the sieving operations on these tests as uniformity in results on any one sieve is of more importance than the possible elimination of personal equation. It is also suggested that in following the standard specifications for sieving, special care be taken to turn the sieve frequently in order to eliminate the effects of uneven distribution or of the direction of the screen wires.

Under separate cover, a copy of Technologic Paper No. 29* is being sent you. This paper contains the standard specifications for sieving and other information bearing on the coöoperative tests here proposed. Further information regarding the purpose or execution of these tests will be gladly furnished upon request.

Further Notes on the Break in the Stony River Dam

Sir—In further comment on the break in the Stony River Dam (ENGINEERING NEWS, Jan. 22, 1914) the following notes made by the writer after a visit to the dam, Jan. 18-19, may be of interest.

Unlike some dam failures the cause of this accident is easily determined from the conditions at the site, and it was gratifying to find that the owners welcomed the closest inspection by anyone who might desire to learn some lesson from the disaster.

It is interesting in this connection to note the action of the same type of dam at Pittsfield, Mass.,† where an inadequate cutoff wall permitted the discharge of the entire pond capacity through a hole eroded beneath the dam without failure of the dam itself. Compare this with the entire failure of a small portion of the Stony River Dam by the same cause, and the entire failure of practically all of the structural steel Hauser Lake Dam in Montana in 1908‡ due to what was at the time reported to be the destruction of the cutoff wall. As the amount of water discharged through the break in each case was apparently roughly proportional to the damage done to the dam, it is quite conceivable that the extent of failure in each case may be largely due to this factor.

One condition which is of interest is the limited erosion under the dam and upstream from the dam at the point of the break as compared to the cavity excavated some thirty or forty feet deep and including apparently some ten feet of shale rock at a point downstream from the dam. Perhaps this can be explained by the protection afforded the bottom by the floor of the dam, which may have dropped to the bottom of the eroded area when the portion of the dam above it gave way. Two sections of this floor still remain in this position and tend to confirm such a theory.

Although the writer walked along the top of the dam after the accident, looking for the expansion cracks which were to be expected at each buttress, it was somewhat of a surprise to find them so few and far between. The remarkable way in which the buttress haunches clung to the deck, first evidenced at the east end of the break and again at several large sections of decks and buttresses found below the dam, seemed to offer good evidence that at least at those points there were no expansion joints.

Another lesson to be drawn from this accident is the necessity of the designing and construction engineer of any engineering work providing the necessary instructions for the proper care and maintenance of the structure. Moreover, these instructions should be so clearly and forcefully presented that their importance will be fully understood and appreciated by the management and carried out accordingly. This prompts the suggestion also that the designing and constructing engineers may oftentimes be consulted to advantage for a period of a year or more after completion, that their experience may the better insure satisfactory results from the completed structure.

H. V. SCHREIBER,
Managing Engineer, Sellers & Rippey.

Stephen Girard Bldg., Philadelphia, Penn.,
Jan. 26, 1914.

Sir—Like most failures of works, that of the Stony River Dam (ENGINEERING NEWS, Jan. 22, 1914) presents features of considerable interest. From the account of the accident it is quite evident the failure was primarily due not to sliding but to the undermining of the foundation. The probability is that the lower part adjoining the surface of the prehistoric rock bed of the river consisted of more or less porous material and that the good clay on top did not extend far upstream. In fact, this view is borne out by the presence of boulders noted on the elevation and the failure is thus easily accounted for. With a head of 40 ft.* of water, a length of travel of some 60 ft. for the percolating current is clearly totally inadequate. It should be more like 240 ft. which could have been provided partly by an artificial rear apron of clay and partly by silt deposit from the river. This latter economical natural process can be generally insured (in the case of a sand or boulder bed) by building the whole dam up to one-half of its ultimate height and leaving it thus unfinished until a season's flood water

*Technologic Paper No. 29 is entitled "Variation in Results of Sieving With Standard Cement Sieves," by Rudolph J. Wig and J. C. Pearson. It presents the results of a number of tests looking into the peculiarities of the personal equation of sieving, the variations in the sieves and the variations due to methods of sieving.—Ed. "Eng. News."

†"Engineering News," Apr. 1, 1909, p. 345.

‡"Engineering News," Apr. 30, 1908, p. 491.

*The head at the point of initial failure was 25 ft. to the original earth surface.—Ed.

has deposited sufficient silt on the bed of the river upstream of the work to insure thoroughly stanching the flow. The length of travel provided artificially need then then be only one-half of that ultimately requisite.

It is considered that the washing out of the clay foundation was largely assisted by the presence of weep holes in the floor. When small apertures are thus provided the hydrostatic pressure can be but slightly reduced and the high velocity of exit will carry up particles of earth or sand from the foundation.

A deep water-tight curtain, carried well into the rock, would have obviated any uplift beneath the work or if the rock itself were porous the provision of a reliable rear apron would have rendered matters doubly secure.

The Bassano Dam on the Bon River in the Province of Alberta, which is at the head of the Canadian Pacific R.R. Eastern Irrigation System is subject to very similar conditions. The dam is also of the Ambursen type, a style of construction successfully tested in a great many existing examples, and is about the same height as the Stony River Dam and is also founded on clay. This foundation is, however, of unmistakably good quality, being hard, blue clay difficult to cut even with a pick and perfectly water-tight. This clay blanket is 10 ft. deep and overlies the original boulder accumulation in the bed when it was a placid river. It extends 1000 yards upstream of the work and thus forms a natural impervious rear apron of such a length as to completely neutralize any injurious scouring action from the under current. The hydraulic gradient is so flat as to render the pressure area of uplift underneath the work too small to be worthy of consideration. Unless some absolutely unforeseen defect shows itself, there can be no penetration of water between the clay and the base of the floor and consequently no liability to sliding. In this dam, holes have been made in the floor and also in the fore apron which are considered by the writer to be as open to objection as they are to the passage of material.

In the new Euphrates Dam, in Mesopotamia, uplift is cared for by inserting a filter bed of riprap 80 ft. wide some small distance downstream of the work. The fore apron then consists of a short length of floor followed by the riprap filter, the impervious apron being then resumed. Percolating water can pass through the filter without carrying sand with it, as must be the case were holes only provided in the floor and the hydrostatic pressure terminates at the filter, the floor beyond it being free from uplift.

W. G. Bligh.

44 Dupont St., Toronto, Jan. 27, 1914.

State Irrigation Work in Australia

Sir—I read with great interest the editorial comment in your issue of Jan. 15, 1913, on "The Financial Troubles of State Irrigation Work in Australia," and I thought that you might be in turn interested in the inclosed statement from F. T. A. Fricke, the Victorian representative in San Francisco, in which he has kindly summarized for me the actual progress made.

Tom C. Mead.

Berkeley, Calif., Jan. 24, 1914.

[Mr. Fricke writes from 687 Market St., San Francisco, Calif., as follows:

The editorial appearing in "Engineering News" Jan. 15, commenting upon the progress of irrigation in the State of Victoria, Australia, is apt to give a wrong impression of the actual stability of the undertaking. The decrease in the actual total area of irrigated lands is explained by the fact that four or five years ago a larger area by over 50% of the ordinary pasture and fallow land was irrigated (this was done last year as the season demanded it and the water was available.

Dr. Elwood Mead, the Chairman of the State Rivers and Water Supply Commission in Victoria, issued a statement to the effect that there has been no period when irrigation in Victoria has made as great a progress as during the past four years, and there is not an irrigation district with a compulsory charge where the facilities for supplying water have not been improved during that time, nor where there were not more orchards, more fodder crops and more irrigation of a permanent character than there was in 1908.

The Government Closer Settlement Policy of irrigated lands was just at this period being initiated and there has since been a steady increase of small holdings by the cutting up of the large estates. The principal district so affected was that of the Goulburn Irrigation Scheme. The last report issued by the Victorian State Rivers and Water Supply Commission showed an increase of 121% of the irrigated areas, or 41,217 acres, the figures for 1909-10 being 33,556 acres and for 1912-13, 74,773 acres. In addition to the substantial increase revealed, the allotment of water has been made for the ensuing year to further area totaling 41,000 acres and the subdivision of another 23,000 is also in hand.

There are now in the Goulburn Irrigation Settlements eight times as many families as there were three years ago. Details of other irrigation districts in Victoria show remarkable improvements in the number of irrigated areas between 1908 and 1912.

The Government has about 50,000 acres now ready for settlement and is proceeding with the preparation of fresh areas as the demand justifies. Prior to the compulsory irrigation charge, introduced by the State Rivers and Water Supply Commission, irrigation in Victoria was haphazard and the works were consequently unfinancial. Under the present system, the charges to settlers are so arranged as to cover cost of supply and maintenance in addition to a sinking fund charge on the original outlay and it is claimed that water for irrigation is provided more cheaply than in any other country.

Besides Mr. Fricke's letter Mr. Mead incloses a clipping from the Melbourne *Argus* of Oct. 30, 1913, which gives extracts from the eighth report of the Rivers and Water Supply Commission which put the progress of irrigation in Australia in a favorable light.—Ed.]

Ladder Dredges in North America

Sir—In your issue of Jan. 15 appears a most interesting article entitled, "Foreign Ladder Dredges." Reference is made to the tendency in America for contractors to limit the cost of their plant by using the dipper type of dredge, considered by some engineers to be the better "as an all around machine, simple in design and of relative low cost."

It should be known, however, that with the recent enormous increase in quantities which dredging contractors in the United States and Canada have had to undertake in their contracts, the dipper type of dredge has proved inadequate and that in many cases the bucket-ladder type is now being preferred. I refer you in this connection to the work done at Boston by the "Denver," the work being carried on now at Courtney Bay, St. John, N. B., by Norton Griffiths & Co., a recent contract at Quebec, and the preliminary work on the new Welland Canal, in all of which bucket-ladder types of dredges have been employed.

A case has recently come to my attention where in good coarse sand and in seven months work a single bucket-ladder dredge with 1-yd. buckets got out more

yardage than three of the most uptodate dipper machines. The advantage lay with the bucket-ladder dredge (by no means of the most uptodate type), owing to its greater reliability and freedom from breakdowns, and no doubt also from the fact that the material was exactly suited to it. It might have been otherwise had the material been mor difficult, including clay or large stones and boulders.

Reference might have been made in your article, however, to the remarkable success of the Simons bucket-ladder dredge "Corozal," recently acquired by the Isthmian Canal Commission for special duty at the Panama end of the canal. The conditions under which the "Corozal" had to work precluded any other type of dredge, and in excavating heavy clay, broken rock and large stones this dredge has exceeded all anticipations in the canal work. It will be employed from now on in the excavating of the rock material in the Culebra slide.

JOHN REID & Co.,
Naval Architects and Marine Engineers.
17 Battery Place, New York, N. Y., Jan. 16.

[The ladder dredges "Denver," at Boston, and "Corozal," on the Panama Canal, were mentioned in our article, and have been described already in our columns. Reference was made also to the improvements in modern dredges of this type. It is interesting to note the additional works referred to by Mr. Reid, but it will readily be understood that the ladder dredge is coming into use as an aditional type of machine and is not proposed to supersede the dipper dredge. In fact some of the largest dipper dredges ever built are now under construction for the Panama Canal.—EDITOR.]

Records of Rail Failures

Sir—In your issue of Oct. 30, 1913, an article on "Rail Failures in 1912" quotes a report stating that the wide variation of results shown by the broken-rail statistics is probably due to lack of uniformity in rolling-mill practice. I believe part of this variation is due to incorrect compiling of the statistics.

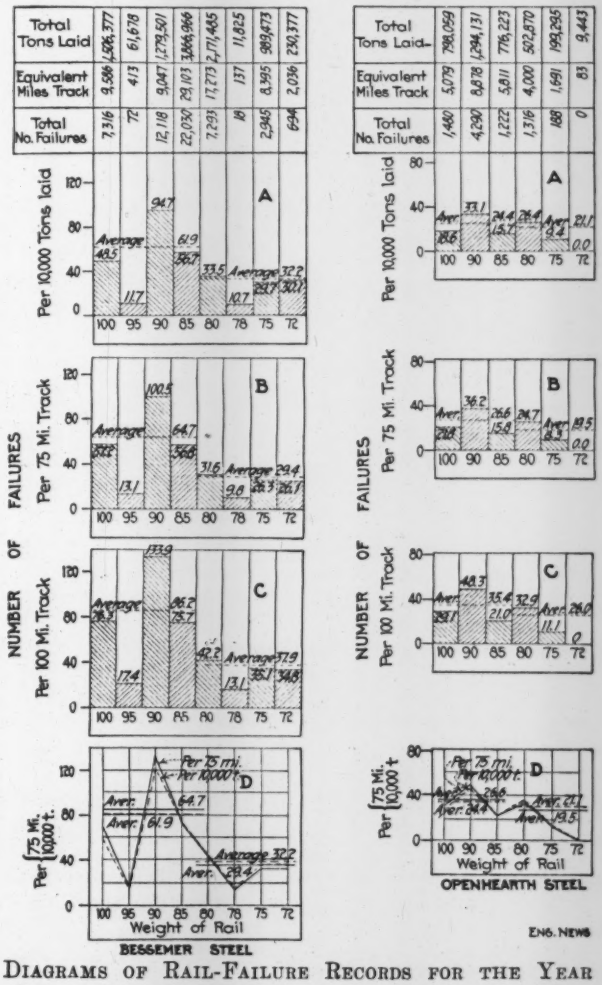
Certain of the statistical tables accompanying the report seem to compare the weights of rail one with another, basing the comparison upon the failures occurring in 10,000 tons of rail originally laid. This would mean, for instance, that the number of failures occurring in 1 mile of 100-lb. rail are compared to those occurring in 1¼ miles of 80-lb. rail, which would be meaningless. A comparison of this nature can be made only on a mileage basis, not on a tonnage basis. I am under the impression that it was once stated that the tonnage basis would take care of rails of different lengths (30 ft., 33 ft., etc.) but have never been able to see how this could be so.

Other tables compare openhearth rail with bessemer rail, on the same basis of failures occurring in 10,000 tons originally laid, using the number of failures reported in 1912. A large proportion of bessemer failures in 1912 occurred in rail five, ten and more years old, or at least occurred only in the small portion of it still remaining in track, to be exact. Although these failures occurred in the small portion still in use, the statistics would seem to indicate that they occurred in the entire quantity originally laid, as if none had ever been removed.

The openhearth failures in 1912 occurred in rail mostly four or five years old, or less, very little in consequence having as yet worn out. In other words, as an example possibly exaggerated, they appear to take the bessemer failures in 300 miles of rail, class them as having occurred in 1000 miles of bessemer rail, and then compare them with what actually did occur in 1000 miles of openhearth rail.

P. S.

[The article in question related to investigations made by the Rail Committee of the American Railway Engineering Association, and our correspondent's letter was referred to that committee for consideration. The following reply is sent to us by Mr. Trimble, Chief Engineer of Maintenance-of-way, Pennsylvania Lines, Pittsburgh, Penn.—EDITOR.]



DIAGRAMS OF RAIL-FAILURE RECORDS FOR THE YEAR ENDING OCT. 31, 1912, COMPARING VARIOUS WEIGHTS OF BESSEMER AND OPENHEARTH RAILS, AS REPORTED TO THE AMERICAN RAILWAY ASSOCIATION

Diagram A. Rail failures per 1000 tons laid.
Diagram B. Rail failures per 75 miles of track; equivalent to 10,000 tons of 85-lb. rail.
Diagram C. Rail failures per 100 miles of track.
Diagram D. Comparison of rail failures per 75 miles of track and per 10,000 tons laid.

Sir—Your correspondent takes exception to the statement "that the wide variation in results shown by broken rail statistics is probably due to lack of uniformity

in rolling-mill practice." He states that he believes, "part of this variation is due to incorrect compiling of the statistics," and that "certain of the statistical tables compare the weights of rail one with another, basing comparison upon the failures occurring in 10,000 tons of rail originally laid." He also states that, "other tables compare openhearth rail with bessemer rail on the same basis."

The Rail Committee, in its report, stated a conclusion "that the wide variation in results must be due to a large extent to lack of uniformity in the performance of different mills, and also to lack of uniformity in the product of any mill." The Committee in arriving at this conclusion did not follow the method suggested by your correspondent, that is, to compare the performance of 80-lb. rail with 100-lb. rail. Nor, in arriving at this conclusion, did it compare the performance of openhearth rail with bessemer rail. A reference to the statistics questioned, will show a careful observer that the results for openhearth and bessemer products have been kept separate.

Where the comparative wear of special rail is reported, comparisons are made between bessemer, openhearth and special alloys, as the case may be.

In order to show just how much there is in your correspondent's criticism of the conclusion referred to, a concrete case is submitted. The accompanying table shows the results of three years' rolling of 85-lb. rail by a steel company, the rails being in service under similar track and traffic conditions on one of the lines reporting:

Year rolled	Tons of rail purchased	Number of failures 1909	1910	1911	1912	1913	Number of Failures for 10,000 tons 1909	1910	1911	1912	1913
1909	4109	168	278	265	216	166	408.9	676.6	644.9	525.7	403.9
1910	8745	...	3	4	14	13	.....	3.4	4.6	16.0	14.9
1911	3349	...	...	6	22	8	.....	.....	17.9	65.7	23.9

This record shows a very un-uniform performance for the output of this particular company. The age of the rail, as noted by your correspondent, hardly accounts for the variable performance. A study of the statistics furnished by our committee will show many similar cases, (See especially tables 2 and 6 in the committee's report, for both bessemer and openhearth rail.)

Diagrams "*A*," given herewith, show graphically rail failures per 10,000 tons laid for different weights of rail of bessemer and openhearth steel.

Diagrams "*B*" show rail failures per 75 miles of track. The reason for using 75 miles of track for the basis, is that this is equivalent to 10,000 tons of 85-lb. rail, 85-lb. rail being a fair average between the lower and upper weights. It will be noted that the general results of the comparison are the same in both cases, although there are some slight differences in detail.

Diagrams "*C*" show rail failures per 100 miles of track, and here again, although there is some change in the figures in detail, there is no change in the general results or deductions to be drawn therefrom. The basis of failure per 100 miles of track is used by the Harriman Lines.

Diagrams "*D*" show a comparison of the results, comparing on the basis of 75 miles of track and 10,000 tons laid.

The question as to the use of miles of rail instead of tons of rail on which to base a comparison of the failures has been discussed a number of times by our committee, and it is admitted that there is a little more accuracy in using the mileage basis. But in order to reduce the labor in compiling these statistics to a minimum, it seemed desirable to use the tonnage basis. Our investigations show that no errors in our deductions can be shown by reason of the use of the tonnage basis instead of the mileage basis. The more accurate method would probably be to count the rails, but this is impracticable.

The members of the committee are sufficiently acquainted with the rail problem not to make the mistake of comparing the performance of 80-lb. rail on one railway with the performance of 100-lb. rail on another railway, where the conditions may be entirely different, and in stating their conclusions the committee has been conservative and can back up each and every conclusion with many records.

We aimed, in drawing the conclusions, to do so from the performance of rails of similar character under similar track and traffic conditions.

R. TRIMBLE.
Chief Engineer, M. of W., Pennsylvania Lines.
Pittsburgh, Penn., Jan. 6, 1914.

The Action of Groined-Arch Roofs

Sir—In your interesting description of the collapse of a portion of the groined-arch roof of Filter 14, Belmont Filters, Philadelphia, in your issue of Jan. 15, 1914, p. 142, you say "the behavior of the structure . . . is not perfectly obvious mainly because of some doubts as to whether a groined-arch roof, such as this, acts as a series of arches . . . or as a series of independent umbrellas. . . ."

The writer was an Assistant Engineer on the construction of many of these groined-arch filters, and is familiar both with the manner of placing and the subsequent behavior.

In placing the concrete, the joint between new and old work is always made at the crown of the arch. Where several arches are placed continuously the shrinkage of the concrete in setting tends to crack it at or near the crown; that being the thinnest section The result is that after completion the roof may consist simply of a collection of such independent umbrellas which are almost or entirely separated from their fellows, and which support any load they may have to carry entirely as cantilevers. I do not mean to say that this always is the case, but that it often occurs and is always likely to occur.

A glance at a section of one of these umbrellas considered as an independent structure shows the futility of depending on it to support any considerable load or even its own weight for an indefinite time. Any slight settlement or disturbance of such a structure is likely to cause its collapse.

The collapse of No. 14 was probably caused by a very slight settlement of the back wall, but the structure had been on the point of failure for many years, and portions of the two filters on either side of No. 14 are so split up into sections by these shrinkage cracks that they are likely to fall at any time.

The fact that the arches adjacent to the collapsed portion are standing as they do shows that there is little, if any, lateral thrust in the structure.

The writer considers that groined arches of concrete

are neither safe nor stable structures unless tied together with steel rods.

JOHN S. ELY,
Assistant Engineer, Bureau of Water.
Philadelphia, Penn., Jan. 22, 1914.

NOTES AND QUERIES

H. W. G., of Lehigh University, sends the following:

Dr. Mansfield Merriman, who was for so many years Professor of Civil Engineering at Lehigh University, was accustomed to tell the following story to his students in bridge design:

In the days when concrete design was not as well understood as now, a low concrete bridge of a single arch had been built over a small river. The chief engineer and his assistants were on the bank of the stream, watching the removal of the false-work from the completed arch. As the last supporting timber was removed, the bridge sank down into the stream in a broken mass. After one astounded look, the chief ran to his near-by office, followed by his frightened assistants. For a long time the chief pored in silence over the plans and computations from which the bridge had been built. Finally with a long sigh he muttered hopelessly, "Damn that decimal point!"

The Injection of Cement Grout into Water-Bearing Fissures*

BY FRANCIS DONALDSON†

The direct injection of cement grout into water-bearing fissures as a means of checking or stopping the flow of water into shafts and tunnels has been experimented with for a decade or longer and seems to have been first attempted in Europe. The earliest application of which the writer has found a record was at a shaft sunk by the Mining Society of Lens; this is described by C. Dinoire in the "Transactions of the Institution of Mining Engineers."

It is only lately, however, that the process has been entirely successful. This success has been accomplished on the Catskill Aqueduct, now under construction by the city of New York. This aqueduct includes a number of deep pressure tunnels, reached by shafts for both waterway and construction purposes. In portions of these shafts and tunnels considerable underground water was met.

The contract for the first of these deep pressure tunnels was let to the T. A. Gillespie Co.; this section is known as the Rondout Siphon. It leads under the Rondout valley at a depth of from 400 to 800 ft. and is about 5 miles long. The engineers expected that considerable water would be encountered, but fortunately this was not the case except at one shaft, known as No. 4, which penetrated the rock at a junction between limestone and conglomerate. Water-bearing fissures were encountered almost immediately. At a depth of about 200 ft. a flow of 1500 gal. per minute was struck. The shaft then contained as many pumps as could be used, and it seemed impossible to sink it further.

After vain efforts had been made to proceed, John P. Hogan, a division engineer of the Board of Water Supply, suggested that cementation of the fissures be tried. The process was attempted for the first time in this country. Since the shaft was partly full of water, it was necessary to drill grout holes with a diamond drill. Platforms were placed on the timbers at the water level, the diamond drill was installed and six 90-ft. holes were drilled in the bottom of the shaft. Several car loads of cement were pumped through these holes into the fissures, the drill casings being used for grout pipes. This largely cut off the flow of water from the bottom and sinking could then proceed.

After that, water-bearing seams were grouted as soon as encountered, and the contractor was able to finish the shafts and tunnel within the contract time.

At Shaft No. 4 of the New York City Siphon, good progress was made until a depth of about 100 ft. was reached. The first hole drilled in the bottom below this depth struck a stream of water; the flow amounted to about 150 gal. per minute. This was plugged. It was found that each of the 12 holes in the sump cut encountered the same stream of water.

As soon as each hole cut the water-bearing seam, it was plugged with a tapered wooden plug. After all the holes in the sump had been drilled and plugged in this way, the grout connections were made one at a time, so as to restrict the flow of water into the shaft. Each connection was made with a piece of 2- or 2.5-in. iron pipe about 3 ft. long, threaded at one end and given a long taper at the other. The tapered portion was made rough on the outside by nicking it with a chisel. A heavy iron stopcock was screwed to the pipe, the tapered end wrapped in several thicknesses of burlap, the wooden plug removed from the drill hole and the tapered pipe driven in, the stopcock being left open. This was the most exciting and the wettest part of the job. After the pipe had been driven in hard, the stopcock was closed.

In this case, connections were placed in all the wet holes before grouting. The grouting machine or tank used on the aqueduct was the Caniff machine, in which the grout is mixed by air. It is built like an air lock with a door on the top through which cement, sand, and water are introduced, and has a 2-in. discharge opening in the bottom and air connections top and bottom. The discharge opening is connected to the grout hole by a heavy rubber hose. Another 2-in. stopcock is placed at the outlet of the tank and a 2- by 1-in. T is placed between the hose and the cock attached to the pipe in the drill hole. Into the side opening of this T a 1-in. stopcock is screwed.

The machine is installed at the bottom of the shaft, and is connected to one of the holes and also to the high-pressure air supply. The 2-in. stopcock on the machine is closed and the other is opened. The door in the top is opened, a sack of cement, three or four buckets of water, and (if the cavity to be filled is large) a sack of fine sand are poured in, the air connection at the bottom is opened and the air allowed to bubble through and mix the grout. Then very quickly the door is closed, the lower air connection is closed, and the discharge connection and the upper air connection are opened, and the air enters and drives the grout into the cavity. A man stationed at the 1-in. stopcock keeps opening it a crack; when air shows instead of grout he closes the 2-in. stopcock and the machine is recharged. If the cavity is open the charge is pushed in in 3 or 4 sec. By working continuously more than 1000 batches can be placed in 24 hr.

The grouting of the fissure was successful and sinking was resumed. About 50 ft. farther down another water-bearing fissure was drilled into, and this, instead of being open, was filled with sand formed by the crushing of metamorphic gneiss due to folding; this sand was carried up out of the drilled holes in large quantities by the water. Grout will not permeate sand and it was necessary to continue drilling holes and pumping in grout, increasing the pressure at the end from 100 to 400 and 500 lb. to the square inch. The sand was tamped so full of cement that when cut through it was compacted like sandstone and contained balls of grout from the size of a fist to as large as a man's head.

The most difficult grouting on the aqueduct was done on the Hudson Siphon, which is a deep siphon tunnel under the Hudson River at a depth of 1100 ft. below tidewater. The shafts were sunk by the city forces, after which the contract for the driving and lining of the tunnel and lining the shafts was let. About 150 ft. from the foot of the east shaft the heading cut a water-bearing fissure which flowed about 300 gal. per minute. The full flow did not develop until the cut was blasted. The problem then was to grout this flow against a hydrostatic pressure of 500 lb. per square inch, with no solid rock to which to make grout-pipe connections.

This problem was finally solved by the construction of a concrete bulkhead 8 ft. thick across the full section of the head. The concrete was mixed in proportions of 1:2:4 and was heavily reinforced with rails set into holes drilled laterally into the sides, roof, and floor of the tunnel. Grout pipes leading into the fissure were set through the bulkhead. After the concrete had set for a week, grout was forced into the fissure, first by the pneumatic process with a high-pressure air compressor and finally by means of a high-pressure plunger pump which forced water instead of air into the grout tank. Pressures were reached in this way up to 1000 lb. per square inch.

In driving or sinking through rock containing a large number of seams carrying small quantities of water, it is not practicable to stop and grout each seam as described above. In this case it is advisable to increase the section of tunnel or shaft sufficiently to allow for a heavy concrete lining. Drains should be provided opposite all of the water-bearing fissures to carry off the water while the lining is being placed. After the concrete has secured sufficient strength, the drains may be grouted. By a combination of these two methods it should be possible to penetrate any firm rock, no matter how much water it contains.

*A paper published in the "Bulletin" of the American Institute of Mining Engineers for January, to be presented at the February meeting of the Institute.

†Engineer, Board of Water Supply, N. Y. City.

The Ohio Flood Prevention and Water Conservancy Bill

Conservancy districts for flood prevention and other purposes are authorized by a bill which was introduced in the extraordinary session of the Ohio Legislature on Jan. 19. The bill, which if passed, will be known as the "Conservancy Act of Ohio," provides that the Court of Common Pleas of any county in the state or any judge thereof when the court is on vacation may on receipt of a proper petition establish a conservancy district within or partly within and partly without any county in the state. Such districts may be created for any or all of the following purposes:

(1) Preventing floods; (2) regulating stream channels by changing, widening and deepening the same; (3) reclaiming wet and overflowed land; (4) providing for irrigation where it may be needed; (5) regulating the flow of streams; (6) diverting, or in whole or in part eliminating water courses.

A petition for a conservancy district may be presented to the court by 100 or the majority of the freeholders in a proposed district, by the owners of more than one-half of the property in value or in acreage within the limits of a proposed district, or by the governing body of a public corporation wholly or partly within the district. Such a petition must give the name of the proposed district and must state "the necessity for the proposed work and that it will be conducive to public health, safety, convenience or welfare." After proper hearing and being satisfied that the purposes of the act "would be served by the creation of a conservancy district" and "after disposing of all objections as justice and equity require," the court shall grant the petition, "thereupon the district shall be a political subdivision of the State of Ohio." In case the court decides against the formation of a district an appeal may be taken to the county court of appeals.

The affairs of the district are to be managed by three directors, appointed by the court which granted the petition. The first three directors are to serve for periods of three, five and seven years, and subsequent directors for five years. The directors are to receive $5 a day and expenses. It is the duty of the directors to prepare, adopt and execute an "official plan" to meet the object for which the district was created.

The conservancy boards would have broad powers, as shown by the following extracts from the bill:

SEC. 15. GENERAL POWERS—In order to effect the protection, reclamation or irrigation of the land and other property in the district, and to accomplish all other purposes of the district, the board of directors is authorized and empowered to clean out, straighten, widen, alter, deepen or change the course or terminus of any ditch, drain, sewer, river, water course, pond, lake, creek or natural stream in or out of said district; * * * * to concentrate, divert or divide the flow of water in or out of said district; to construct and maintain main and lateral ditches, canals, levees, dikes, dams, sluices, revetments, reservoirs, holding basins, floodways, pumping stations and siphons, and any other works and improvements deemed necessary to construct, preserve, operate or maintain the works in or out of said district; to construct or enlarge or cause to be constructed or enlarged any and all bridges that may be needed in or out of said district; to construct roadways; * * * * to remove or change the location of any fence, building, railroad, canal, or other improvements in or out of said district; and shall have the right to hold, encumber, control, to acquire by donation, purchase or condemnation, to construct, own, lease, use and sell real and personal property * * * * etc.

SEC. 19. MAY MAKE REGULATIONS TO PROTECT WORKS—Where necessary in order to secure the best results from the execution and operation of the plans of the district, or to prevent damage to the district by the deterioration or misuse, or by the pollution of the waters, of any water course therein, the board of directors may make regulations for and may prescribe the manner of building bridges or fences or other works in, into, along or across any ditch, reservoir or other construction; and may prescribe the manner in which ditches or other works shall be adjusted to other works connected with the works of the district or any water course therein; and, when not in conflict with the regulations of the State Board of Health, may prescribe the manner in which the water courses of the district may be used for sewers or outlets or for disposal of waste.

In addition, the directors are given a "dominant" power of eminent domain over railroad, telegraph, telephone, gas, water-power, or other companies or corporations and also over townships, villages, counties and cities. The conservancy districts may coöperate with the United States government, with state governments, or with drainage or other districts.

Any conservancy board *may* "employ a chief engineer who may be an individual, copartnership or corporation," and also "such other engineers" as may be needed. The bill also provides that "the chief engineer shall be superintendent of all the work and improvements."

The act limits the rights of water users in any district to those possessed by them before the district was organized and improvements were made and provides for short-term leases for any higher use of water made possible by the improvements and actually profited by. Where all applications for these increased or higher uses cannot be granted the following order of preference shall be observed: (1) domestic and municipal water-supply (with no charge for private home and farmyard use); (2) manufacturing and allied purposes, "and for maintaining sanitary conditions of stream flow"; (3) "irrigation, power development, recreation, fisheries and other uses."

The first cost, capital charges and maintenance expenses for any and all work done under the bill would be borne by the property benefited, the benefits to be determined by three assessors, nominated by the directors of the district and appointed by the court of jurisdiction. The assessments to meet capital outlay must be confirmed by the court, after hearing, provided the benefits found exceed the cost. Individuals have the right of appeal. Where villages, cities or counties are assessed the assessments are to be met by general taxation. The directors may issue bonds up to 90% of the cost of improvements.

So far as appears from the bill the directors of any conservancy district are responsible to no one except to the courts, and to the courts only in legal proceedings, but it should be remembered that districts are formed only on petition and after hearing, and for purposes stated by the petitioners.

The bill passed the lower branch of the Ohio legislature on Jan. 22, by a vote of 88 to 18.

Report on Sewage Testing Station at Akron, Ohio

There has just been made public an interesting report on the operations of a sewage testing or experiment station at Akron, Ohio. The station was put in partial operation on Jan. 1, 1912; the experiments extended over a period of eight and one-half months; and the report covering all the work done was dated Oct. 12, 1912.

The conclusions drawn from the report are that the sewage of Akron can readily be treated by means of Im-

hoff tanks and sprinkling filters, followed by a brief period of sedimentation; and that the manufacturing wastes of the city, which some had believed would make the sewage-treatment problem a very difficult one, would not interfere with the successful operation of the sort of works recommended.

The testing station was in charge of Harry B. Hommon, who at the present time is in charge of the Cleveland sewage-testing station. The report is addressed to Robert M. Tillmore, director of the Department of Public Service. At present, Frank W. Rockwell is Mayor of Akron.

The population of Akron in 1910 was about 69,000, and the estimated population in 1912 was 75,000. The chief industries of the city are breweries and paper mills. Only rubber, salt and paper-mill wastes are likely to interfere with ordinary sewage treatment. The average daily water consumption of Akron in 1910 was 7,340,000 gal. Akron is located on the Little Cuyahoga River, a mile above the junction of that river with the Cuyahoga. The larger part of the hundred miles of sewers in Akron is on the separate system, the combined sewers all being in a central district. For various local reasons a large amount of ground water enters the sewers. According to the U. S. Geological Survey the extreme dry-weather flow of the Cuyahoga River at Independence, below Akron, for the period 1903-06 was 56 cu.ft. per sec., or 36,000,000 gal. for 24 hr. On the basis of a required dilution of 5 cu.ft. per sec. per 1000 population, this minimum flow would be sufficient to satisfactorily receive the sewage of only about 15% of the population of Akron at the time the report was made. In the fall of 1910, owing largely to lawsuits brought by riparian owners on the Cuyahoga River, the city began to investigate the sewage-disposal problem. It engaged for this purpose E. G. Bradbury, who in a preliminary report advised a series of tests, which among other things would give consideration to trade waste.

An appropriation of $10,000 was made for the construction, equipment and operation of the sewage-testing station and all the work done was carried out within that figure. Briefly, the testing station included a gas-engine-driven centrifugal pump which lifted about 50,000 gal. of sewage per day from a 42-in. outfall sewer through a 4-in. force main 240 ft. long to the testing station. The plant in this station included a grit chamber, an Imhoff, a Dortmund and a septic tank; three sprinkling filters, with small secondary settling basins; contact beds; a sludge tank and an orifice tank for measuring the sewage flow. Some further particulars regarding the various elements in the plant are given in the summary printed below. In addition, it may be stated that the diameter of the Imhoff tank was 8 ft., that it had a total capacity of 4693 gal., of which 2038 gal. was in the sedimentation compartment. The Imhoff tank removed suspended matter as follows: Maximum, 61.9%; minimum, 26.8; average, 48.4%. The minimum was in July and was attributed to the clogging with suspended matter of the slots which form the connection between the sedimentation and digesting compartments of the tank. It is assumed that a fair average removal of suspended matter would be 50%. The sprinkling filters were equipped with Taylor nozzles.

We reprint in somewhat condensed form the summary and conclusions of the report:

THE AKRON SEWAGE—The composition of the local sewage was learned from 103 analyses, consisting of 2616 portions collected hourly day and night, during the tests. This sewage is representative of the entire sewage of the city. During storms, large quantities of clay and sand are carried by the sewage, but, ordinarily, the analyses show the Akron sewage to be chiefly of domestic origin and of moderate strength.

The sewage contained unusually large quantities of salt, corresponding to 6.28 tons of pure salt per million gallons. The suspended solids averaged 238 parts per million, by weight, equivalent to practically one ton of dry material for each one million gallons.

INDUSTRIAL WASTES—Of the industrial wastes of the city, only those from the rubber reclaiming plants, the salt works, and breweries flow into the city sewers. The others enter the river or the canal. None of these latter wastes at present, cause objectionable conditions, and should such occur in the future, dredging operations in the river, or in the canal, or settling tanks constructed at the mills, might be desirable. For short periods there were in evidence at the sewer outfall relatively large volumes of strong manufactural wastes, but it is a fact, shown conclusively by these tests, that in the general average the industrial wastes of the city do not materially affect the normal composition of the local sewage, nor prevent its successful final treatment on filters.

PREPARATORY TREATMENT—In addition to a small tank for removing sand, there were studied Imhoff, Dortmund and septic tanks. The first two were circular in form, and the last was rectangular. The Imhoff tank had a conical bottom, was about 16 ft. deep, of such capacity that 2.3 hours were required for the sewage to flow from the inlet to the outlet, and contained a separate compartment for sludge. The Dortmund tank also had a sloping bottom, a capacity of about 2.7 hours' flow, but no means for storing the sludge apart from the flowing sewage. The septic tank was a level basin, about 8 ft. deep and of about 7.4 hours' capacity. All of these tanks were open to the air.

Under a velocity of about 60 ft. per min., there was removed by the grit chamber 0.2 ton of sand per million gallons of sewage treated. It was found practical to retain in the Imhoff and Dortmund tanks about 50% of the suspended matters in the crude sewage, or 0.5 ton of dry solids per million gallons. The septic tank removed on an average of 63.9% of the suspended solid matter. Its efficiency and that of the Dortmund tank was greatly impaired by fermentation and upheavals in the deposits in these tanks. Under like conditions of operation, the efficiency of the Imhoff tank was much superior.

It was shown by the tests that during the summer months it would be necessary to remove the sludge from the Dortmund and septic tanks at frequent intervals, in order to prevent large masses of previously deposited sludge, under the active fermentation incident to warm weather, from rising to the surface, escaping with the effluent, and clogging the sprinkling filters.

It follows that not only must the settling tanks be of such construction that the removal of suspended matter will be high, but also they must be of such design as to prevent the contamination of the flowing sewage by putrefaction in the stored sludge.

Such provision is an essential feature of the design of the Imhoff tank, and results obtained during these tests substantiate these claims. The efficiency of the tested unit was nearly 50% and the sludge was more readily drained, more thoroughly digested, and less offensive than that from either the Dortmund or the septic tank. Furthermore, in the deep separate sludge compartment, sludge could be stored for four months or longer with no detrimental effect upon the removal of suspended matter.

The evidence obtained during these tests clearly shows that tanks of the Imhoff type are readily adaptable to local conditions, and when operated in conjunction with sludge drying beds will provide more satisfactory removal of suspended matter, and a better solution of the sludge problem than tanks designed in accordance with the Dortmund or septic tank principle.

The tests show that the period of flow in the upper compartment of Imhoff tanks for Akron may be about 2.5 hours. It will be necessary to provide for an average net accumulation of about 2.3 tons of wet sludge per million gallons.

SPRINKLING FILTERS—The relative advantages of broken stone and broken sewer pipe in filters were especially studied. These test filters were 13 ft. 7 in. in diameter and 5 ft. and 6 ft. deep.

It was found that the local sewage could be satisfactorily treated by sprinkling filters, when operated at a rate of 2,000,000 gal. per acre in 24 hours. Suspended solid matters were discharged from these filters equivalent to an average

deposition of from 2.5 to 5 cu.yd. per million gallons, or about 0.5 ton of dry solid matter for each million gallons. It is necessary to settle the effluents of these filters in basins holding about 2 hours' flow, preferably provided with a separate sludge compartment, or other means for frequent cleansing. The sludge can be readily dried on special sludge beds. The effluent from these basins when diluted with equal parts of river water, a dilution possible for the entire sewage of the city even under the minimum flow in the Cuyahoga River, was not subject to further putrefactive decomposition.

Stone and broken sewer pipe of the same depth gave practically equal results. At 6 ft. depth, the stone filter was much superior. Improvements in means for spraying the sewage would, no doubt, result in higher efficiencies than were observed during these tests. No objectionable odors were noted near the filters when in operation.

The tests showed that the glazed surfaces of broken sewer pipe do not appear to be sufficiently rough to afford proper support for the organic films essential to most efficient results. Although the first cost of broken sewer pipe might be less than that of stone, the tests show that this advantage will be outweighed by increased difficulties of operation, for it is clearly evident that filters constructed of broken sewer pipe will require more frequent cleaning and renewal than filters of broken stone.

It was further developed that the wastes from the rubber reclaiming plants must be screened to prevent the excessive clogging of the filter nozzles by small pieces of rubber.

CONTACT FILTERS—Contact filters consist of watertight basins provided with suitable inlet and outlet valves and containing from 3 to 5 ft. of hard, weather-resisting material, crushed, ordinarily, to a size ranging from ½ to 2½ in. and over.

The evidence obtained during these tests strongly indicates that, under local condition, contact filters operated at a rate of 600,000 gal. per acre in 24 hours cannot successfully purify the settled Akron sewage. Should engineering features indicate the necessity for contact filters in conjunction with settling tanks, the evidence strongly supports the view that satisfactory results could be secured only by providing secondary filters to supplement the work of the primary units.

PLAN RECOMMENDED—These tests have clearly shown that the sewage of the City of Akron can successfully be purified at a plant which would comprise:

1. A small grit chamber for the removal of sand.
2. Imhoff tanks of a capacity equivalent to a period of flow of about 2.5 hours, and sludge beds corresponding to an average net accumulation of about 1.4 tons of dry solids per million gallons. (Drying period—July 1 to Nov. 1.)
3. Sprinkling filters operated at the rate of 2,000,000 gal. per acre in 24 hours, and small settling basins of about 2 hours' flow, with ample means for the withdrawal of sludge.
4. Adequate means for the disposal of an accumulation in the settling basins of about 0.5 ton of dry solid matter per million gallons.

The evidence is conclusive that such a plant would purify the sewage of Akron in a most thorough manner, and under continued proper operation and efficient supervision would prevent all visible contamination of the Cuyahoga River below the outlet of the Akron sewers.

Annual Meeting of the Kansas Engineering Society

The sixth annual meeting of the Kansas Engineering Society was held at Lawrence, Kan., Jan. 20 and 21, in the Engineering Building of Kansas University. Chancellor Strong, of the University, delivered the address of welcome.

The topics that created the most discussion among the members of the society were those concerning good roads, better bridges, and more competent County Engineers. A feature of the convention was the paper read by Prof. H. A. Rice, of the School of Engineering of Kansas University, wherein he strongly advocated more strict supervision of public highway construction work and urged that the convention authorize its President to appoint a committee of three, to make a careful investigation of the workings of State Highway Supervision in other states, and report their findings and recommendations to the next meeting of the society.

At the close of Prof. Rice's paper, Mr. Leason moved the following resolution:

Resolved that a Committee of three be appointed by the President at this session, whose duties shall be to make a careful investigation of the workings of State Highway Supervision in other states, and collect such other information from all other available sources as will enable this committee to make a complete report of their findings and recommendations to the next meeting of Kansas Engineering Society. The Commiteee to meet and coöperate with other state associations interested in good roads legislation.

Kenyon Riddle, Town Manager for Abilene, Kan., Prof. H. A. Rice and Alva J. Smith were appointed by President Meade, to act as the committee called for by the resolution.

Kenyon Riddle's paper on "Town Management" opened up an entirely new field for discussion by the society, and much interest was displayed. Mr. Riddle is the first town manager to be appointed in Kansas, and his paper explained in detail his work as Town Manager of Abilene. A. H. Worley read "A Report on Bridges in Cloud County, Kansas." Mr. Worley's paper stated that 299 bridges and culverts in Cloud County, Kansas, were inspected by him, and recommendations in regard to improvements necessary were made to the board of County Commissioners and were carried out. His paper was followed by an address on "Highways," by W. S. Gearhart, State Engineer.

Mr Gearhart criticized severely the method of expending public funds for highway improvements. In part, he said:

The townships and counties of Kansas are spending annually about $5,000,000 for roads and bridges or about $50 per mile. This sum is about one-fifth of all the taxes raised in the state. There can be no economical expenditure of these funds under the present system. It is not more money that is needed at this time to improve our highways, but an efficient, practical system which will make it possible to spend this sum judiciously.

The County Engineers, County Surveyors, and other engineers interested in the development of the state, whether they are contemplating going into highway work or not, are, and should be, interested in the establishment of an efficient system of road management, and the enactment of a county highway or district engineer law, which will make it at least possible to construct and maintain the roads and bridges at a reasonable cost. Mr. Wilson, Ex-Secretary of Agriculture, stated a few years ago that one of the strongest arguments against national aid for public highways was the lack of experienced men to spend the money.

We need competent officials and fewer of them. The smaller the number in each road unit, the better. Each township and county in the state needs the services of an able, experienced engineer, clothed with proper authority and liberally paid to assist them in solving their highway and bridge problems.

District Highway Engineers or Managers should be appointed on their merits only, by the County Commissioners for a term of not less than four years, but there should be a simple, direct means of removing them from office at any time, for cause. No person should be eligible for appointment until he had secured a certificate of approval from a State Board of Examiners, composed of Engineers. The educational examination and inquiry into the applicant's experience and reputation should be such as the Examining Board deems necessary to fit the applicant to perform the duties of the office. The educational examination should not be too technical. It is an honest, capable, practical, experienced man, rather than special technical ability that is needed under present conditions.

There are 101 County Surveyors in the state, and about 10 County Engineers who are not County Surveyors. This makes a total of 111 officials. Forty-five District Highway Engineers employed by the year so they could definitely plan their work, can, with the assistance of one man about half of the time, do the work these 111 men are now doing, and

in addition, all the other road and bridge work that will be required until Kansas begins to build the more expensive types of roads. This means that about 65 competent men could take the place of these 111 officers. It also means that all the townships and counties would have the services of a capable highway engineer and county surveyor. To employ the kind of men needed to handle the work in each district, will require that they be paid a salary of from $1200 to $2000 per year, or an average of about $1500 and their traveling expenses. If the positions of county engineer and county surveyor were combined and a District Engineer employed on a yearly salary, all survey fees should be turned over to the county road fund. It would then cost a total of about $200,000 per year, or about 2% of the state road and bridge funds to provide the services of competent engineers and surveyors for every township and county in the state.

There is little question but that an efficient merit system of road and bridge administration in Kansas would effect a saving of $1,000,000 and probably a good deal more.

The evening session was devoted to lectures illustrated by lantern slides. Prof. Grandville R. Jones gave an illustrated talk on the filter plant at Washington, D. C., and D. B. Luten, one on reinforced-concrete bridges. The Boulder, Colo., Hydro-Development Co.'s plant was discussed by Prof. Ray Jones, C. E.

The last day's sessions were occupied with papers on subjects chiefly of great local interest. Municipal Ownership in Kansas City, Kan., was discussed by James A. Cable, a member of the Kansas Public Utilities Commission, and formerly manager of the Water and Light plants of Kansas City, Kan.

The society was organized at Topeka, in 1909, and today has an active membership of 117 engineers. Twenty-two new members were added during the past year. The next annual meeting will be held in Topeka.

The following officers were elected for the ensuing year: President, Prof. H. A. Rice, Kansas University; Vice-President, T. J. Strickler, Engineer for Public Utilities Commission of Kansas; Secretary-Treasurer, C. A. Forter, Topeka, Kan.

The Engineer-Manager Plan at Abilene, Kan.

A paper dealing with the advantages of centering the administrative work of at least small cities and towns in a single engineer-manager and outlining some of the experiences under this plan at Abilene, Kan., was presented before the Kansas Engineering Society in January, 1913, by Kenyon Riddle, town manager of Abilene.

After mentioning the advantages of the commission-plan of city government, with its concentration of responsibility and power, Mr. Riddle urges that cities should go one step further in following the methods of business corporations, and centralize executive responsibility in a single manager—instead of having five managers of equal authority with the resulting confusion and jealousies. That is, the commission should be responsible for what is to be done and the manager for doing it. Mr. Riddle adds:

> The manager, being a salaried man with no definite term of office, naturally would strive to give his best service, since the length of his term depends upon his capability.

Quoting now from the paper, with some condensation:

> The preparation of the engineer-manager should consist in a thorough education along the lines of general engineering rather than a knowledge of a few special branches. This will make it possible for him to advise and check up, in a general way, every act of the engineering department. He should also have an understanding of values and be able to estimate all classes of construction and maintenance work, be economical and able to establish systems of record-keeping and cost data and have a general conception of business methods and finances. In addition to this, he should possess an understanding of the city's sanitary and social conditions. These include street cleaning and garbage disposal, water supply, sanitary sewer system, drainage system, the working and living quarters of every class of people, the transportation facilities and numerous other items.
>
> A general knowledge of all these subjects is not too much to expect of a city manager. However, since men have not prepared themselves for this position, it may be well to try the new system of control in smaller towns, for in these places some of the qualifications of manager can be stricken out entirely and others are of much less importance. On the other hand, in the larger cities the different departments are more complete in themselves and would require less direct supervision and advice from the manager.
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> The requirements enumerated indicate that the great majority of the city's affairs are of an engineering nature and should be managed by an engineer.
>
> In the small town, the main object is to devise some scheme whereby the town can feel justified in having the services of an engineer at all times, and this remedy lies in the engineer-manager plan. It will be shown later on how the creation of this office is possible for any town and how it can be made remunerative.
>
> The principal waste of city funds comes from lack of knowledge. This is most often conspicuous in the engineering department, and since the great majority of the city's business is of an engineering nature this makes up the greatest waste. This is positively true of towns which are believed to be too small to need an engineer the year around. Here lack of knowledge is the principal reason for receiving about 75c. value on every dollar spent in taxes.
>
> If a town or city had some means of figuring the money wasted in prospecting for lost underground systems, in the improvements buried and never found, in systems that are built with no idea of future growth and that have to be abandoned years before they are worn out, in the grading and regrading of streets, in sinking hundreds of dollars into permanent culverts and waterways built with no idea of future drainage and that have to be broken out when pavement is laid, it would be no difficult matter to prove the economy of city planning and of proper management.
>
> How could anything else be expected from a council or commission composed of bankers, lawyers, farmers and men who have devoted their efforts to their professions and who are in active business and cannot neglect their business to make a study of engineering so as to carry out some drainage proposition or the like for the city, their salaries being anything from $1 to $25 per month?
>
> As soon as a town reaches a size which justifies permanent improvements, from that time on systematic methods should be carried out, and a capable man who is paid a fair salary and feels permanency in his position is more apt to be able to do these things than a council or commission.
>
> With an engineer-manager it is possible to get the very best and most active business men to serve on the commission, since their duties are reduced to a few hours a week. Furthermore, it is generally admitted that the holding of a political job is not a successful means of increasing one's business, but under the new plan all complaints and grievances may be put up to the manager, such as come up every day because of a lack of water pressure, sluggish sewers, poor drainage, etc., and since he is not elected by the people but appointed by the commissioners he may be free to act as one whose best judgment is not overpowered by political fear. By hiring a manager the hindrances of politics are eliminated and professionalism is substituted.

After citing savings which might be effected by reducing waste, inefficiency and neglect, Mr. Riddle mentions various sources of income which together would more than pay the salary of an engineer-manager.

> The employment of an engineer as manager no doubt will be considered too expensive, especially for a small town. The value of the records which it is possible to keep under this plan would more than meet objection. But there are several ways in which an income to the city's general fund can be realized by the newly created office: No matter how small the town, all sewer work, plumbing, wiring, water mains and services, meters, etc., should be inspected, and the small cost for doing this should be charged to the property owner. Then there will be the ordinary expenses of surveying lot-lines, giving lines and grades for buildings and sidewalks; these would be charged to the property owner and turned into the general fund. Also, there will be the usual engineering for sewer and water extensions, curbs and pave-

ments. And finally, if the manager has charge of the street work, the street commissioner's salary may be saved. The aggregate of these different amounts, if the town were doing its share of improvement work, would average from $100 to $150 per month, a sufficient amount to employ a competent engineer, without extra draft on the city's funds.

Coming next to actual experiences at Abilene, Kan., during eight months under commission government and an engineer-manager, Mr. Riddle states that during the period named that town of some five thousand inhabitants spent $80,000 on streets, about $8000 on water-works improvements, and $2000 on sewer extensions. Besides, it added $1200 to the $6800 spent by the light company for an ornamental street-lighting system. Savings were effected through the well known advantages incident to preliminary estimates, plans and specifications, inspection and final estimates. All materials were bought by the city and contracts were let to the lowest bidder. A reduction of unit costs on sewer work is reported by Mr. Riddle, as follows: Excavating and filling trenches having an average depth of 8 ft., from 40.8 to 25c. per lin. ft.; furnishing and laying 6-in. vitrified pipe, 19.5 to 15c. per lin.ft.; furnishing material and building flush tanks, $66 to $51.80; manholes, $40.80 to $23 each. On 4721 lin.ft. of sewer, three flushtanks and four manholes, the total saving was $1072. On 5010 ft. of water-works extensions, a saving of $400 is figured, and on 2,215,797 sq. yd. of street cleaning (92,000 actual area cleaned for six months), $842, the cost for the latter being 36.2c. in 1913, as compared with 40c. in 1912. Mr. Riddle figures a total of $2315 saved for the year, besides which "the city has a complete set of records of all underground work and of every survey made."

As to the relationship of the commission and the engineer-manager in authorizing and executing work, and by way of final summing up of his interesting paper, Mr. Riddle says:

> In order that all important work shall be authorized by the commissioners as a body, with a clear understanding on their part, a report of the coming week's work is made up, with a preliminary estimate of the cost and an account of the benefits derived. This is presented by the manager at the meeting of the board and after the work is discussed the commissioners order that which they deem necessary. The manager then takes charge and at the next meeting of the board he reports on its progress; or if it is completed, he submits the final estimate. With this procedure the commissioners are thoroughly acquainted with all of the city's affairs.
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> With all of the principles which have been discussed here and with the conclusive evidence of efficiency which has been cited as attained by the business-like methods which are possible in the engineer-manager plan there seems to be absolutely no question that it is the ideal form of public control, particularly for municipalities, and probably most applicable to the smaller towns while in its experimental state.

The Cooling of Buildings in the hot and dry climate of India is a problem which has been attacked by engineers for many years, owing to the very trying effect of the climate upon white men. Various methods are in extensive use. A method which employs air currents through hollow walls and roofs has been proposed, the currents being induced by an electric fan. Where windows and doorways partly close the hollow space in the walls, baffles would be placed to equalize the flow around these obstructions. The fan would be at the highest point on one side and the inlet at the lowest point on the opposite side. The side most exposed to the sun may be made a separate unit. The air entering the hollow spaces could be cooled by water-cooled screens, as is now done for air entering the buildings. It is estimated that the cost for electricity would be from 8 to 12c. per 12-hr. day. This system has been patented by John W. Meares, electrical adviser to the Indian government, at Toryne, Simla (India).

Annual Meeting of the Canadian Society of Civil Engineers

The two most important matters before the annual meeting of the Canadian Society of Civil Engineers, held at Montreal, Jan. 27-29, 1914, were a full report of the committee on concrete and reinforced concrete, and animated discussion over the demand of Western members of the society for greater local control.

The committee reports, other than that on concrete, covered sewage disposal (R. S. Lea, chairman), conservation (James White, chairman), and establishment of government testing laboratories (C. H. Keefer, chairman). They were essentially progress reports, bringing out no definite matters or recommendations of general interest. No technical papers were presented.

The society made two interesting visits during the meeting: to the plant of the St. Lawrence Bridge Co., at Rockfield, near Montreal, which shops were built specially for constructing the new Quebec Bridge; and through the Mount Royal tunnel of the Canadian Northern Ry., which was holed through a month ago and now shows all stages of progress except heading work.

The President of the society, Phelps Johnson (Dominion Bridge Co., and St. Lawrence Bridge Co.), presided over the meeting. His presidential address, dealing with the possibility of enlarging the society's field of usefulness, gave some well matured suggestions for improving the publications and also the direct service of the secretary's office. The election of officers for the coming year resulted as follows: President, M. J. Butler (Montreal); Vice-President, R. A. Ross (Montreal); Members of Council, J. M. R. Fairbairn (Montreal), Prof. H. M. Mackay (Montreal), R. McColl (Halifax), A. R. Decary (Quebec), R. F. Uniacke (Ottawa), W. A. Bucke (Toronto), F. Lee (Winnipeg), and G. R. G. Conway (Vancouver).

Concrete and Reinforced Concrete—The report of the Committee on Concrete and Reinforced Concrete was in substance a complete specification for the design and execution of concrete work. It goes beyond a mere concrete specification in some particulars, as where it prescribes a load reduction for columns which is similar to that of the New York building code. Its provisions are in general safe and sound, with, however, some strikingly individual features such as limiting reinforced-concrete columns (all piers over six diameters long are columns and all columns must be reinforced) to a length of 15 diameters, except that hooped columns may not exceed ten diameters.

Building construction is limited to concrete not leaner than 1:2:4. A table is given of minimum period of removal of forms, ranging from 2 days for wall forms up to 20 days for posts under beams and girders; in the count, however, periods during which the temperature has been below 35° F. shall not be included. Field test-pieces of concrete are called for, two from each day's work, and "the test-pieces shall be carefully examined before the form work is removed." Test loading of concrete floors (which *may* be applied) must not exceed 1½ times the live-load for which the floor was designed, and if no permanent deformations result from such loading the test is to be considered satisfactory.

Considerable comment followed the presentation of the committee's report. It comprised a number of suggestions for improvement in detail. The general tenor of the report appeared to be regarded as satisfactory. Cooperation with other societies who are preparing or have prepared concrete specifications was suggested, but in reply this was declared to be impracticable (as it obviously is). Various ways were suggested in which the report might be brought before the local sections of the society for discussion after having been revised by the committee. The final arrangement made was: to continue the committee until the next annual meeting; to have discussion on the report at the various local-section meetings in addition to the discussion already received; to have the committee reconsider its report in the light of these discussions, and subsequently report to the Council. It is understood that the committee's report to the Council may be in such final form as to permit the Council to adopt the report on the part of the society.

NATIONAL TESTING LABORATORY—A committee on Establishment of Testing Laboratories has repeatedly urged the Canadian government to establish a National Testing Laboratory, but has had no success. The further prosecution of these efforts can be as well conducted through the Council of the society, and with this in mind the committee at its own request was discontinued.

SEWAGE DISPOSAL—The project to appoint a committee on Sewage Disposal, which was under consideration by a special committee, was recommended to be dropped inasmuch as a committee on this subject reported last year after three years' work.

CONSERVATION—The committee on Conservation limited its report to the presentation of a number of communications urging various lines of work on the part of the government, from stream gaging and river improvement to aiding the starving Indians and discovering ways of utilizing sawdust.

VARIOUS COMMITTEES dealing with such subjects as steel rails, specifications for steel bridges, etc., engineering education, and the status of the government engineering service reported progress and were continued for a year.

NEW COMMITTEES—A committee was appointed to consider the matter of drafting *uniform general clauses for contracts and specifications*. This brought forth considerable discussion, some of it rather critical, but the motion prevailed.

A committee on Cast-Iron Water Pipe and Specials was appointed, to report at next year's annual meeting.

INTERNAL AFFAIRS—Sectional feeling has developed in the society within the past year, arising apparently from the desire of the members of the society in the far West to secure a greater degree of autonomy and more influence on the conduct of the society. This crystallized in the presentation of a proposed new by-law establishing provincial divisions of the society with complete control of their own membership. A modified form of new by-law was suggested by the Council of the society, and both by-laws were submitted to vote of the society at large. Both were lost, however, while, on the other hand, several minor amendments were carried.

PRIZES—The Gzowski medal of the society was awarded to Julian C. Smith (Montreal). The sectional prizes of the society were left in a somewhat uncertain condition, as the award in the mechanical and mining sections was left to the Council, no papers were submitted in the electrical section, and a tie was reported in the general section.

Annual Convention of the Illinois Society of Engineers and Surveyors

The 29th annual meeting, held at the Jefferson Hotel, Peoria, Ill., on Jan. 28-30, was a very successful affair, with a good attendance, a list of good papers and, best of all, active discussions on several of the subjects dealt with in the papers, while nearly 40 new members were elected. The formal opening included an address of welcome by the mayor, Mr. Woodruff, and an address by Willis Evans, of the Association of Commerce, on "Manufacturing in Peoria," dealing with the varied industries of the city.

The president, L. K. Sherman (Chicago), in his address, discussed "The Functions of the Engineering Society," and expressed the opinion that in addition to their technical and literary functions, such societies should undertake active work in advancing the interests of engineers and engineering as well as of the public. This would include exercising supervision over proposed legislation, recommending appointments to public commissions, dealing with matters regarding ethics and salaries, and in other ways working with a view to the business side of the profession. The report of the secretary and treasurer showed a membership of about 250 and a cash balance of about $1000.

The subjects receiving the most attention were those in relation to sewage and paving. The report of the Committee on Sewerage and Sewage Treatment presented a summary of present conditions, and noted particularly the need of more extended records as to cost of construction, operation and maintenance of sewage-treatment plants. It included also a number of inquiries and replies in regard to sewerage work. A short paper by Langdon Pearse and S. A. Greeley (Sanitary District of Chicago), dealt with the design and operation of small sewage-pumping stations. Two other papers were on "Oxidation of Sewage," by L. K. Sherman (Chicago) and "Construction Methods and Cost for Large Brick and Concrete Sewers," by H. R. Abbott (Chicago).

In regard to paving, the advocates of brick, concrete and wood all had their innings. The subject of "Brick Paving Roads and Streets" was dealt with by W. T. Blackburn (Paris, Ill.), while a paper by Ernest McCullough (Chicago) discussed "Concrete Paving for Roads and Streets," and A. H. Hunter (Illinois Highway Commission), described the construction of a concrete highway at La Salle, Ill. There was a paper also by J. T. Voshell (U. S. Office of Public Roads) on "Brick and Concrete for Country Roads," outlining the proper methods of construction, but showing that such materials cannot be justified economically for more than a comparatively small percentage of the total mileage of public roads.

A paper by Wm. F. Harvey dealt with "Creosoted Wood Block Paving in Chicago," and the report of the Committee on Roads and Pavements pointed out that a shortage in the supply of blocks had been caused in some cases by the adoption of the Chicago specifications, as there is a limited supply of oil which meets these par-

ticular specifications. The report referred also to the use of concrete paving for alleys in Chicago, and to the admission of both stone and gravel for such concrete. Mr. Dowdell thought that concrete would be suitable for streets of light traffic in Chicago if a satisfactory expansion joint should be developed and if the cutting of the pavement could be avoided by requiring all underground work to be done in advance.

In regard to the new Illinois law establishing the position of County Superintendent of Highways, there was some criticism as to the examinations held for candidates for this position. Under this law, plans for all bridge work in which the county is interested may be prepared by the County Superintendent, by the State Highway Commission or by any engineer or contractor, but plans must be approved by the Commission and the Superintendent. This approval is not required for township bridges, but as the County Superintendent must approve all expenditures of road and bridge funds exceeding $200, he has some control of these bridges also.

The counties generally have not shown their appreciation of the importance of engineering, having fixed the salaries of their County Superintendents at from $2 per day to $2500 per year; Cook County (comprising Chicago) has provided $4000 per year. However, it is thought that the law will have an educational effect which will lead to a better appreciation of the value of the services of engineers.

A paper on "The Testing of Drain Tile" was presented by D. A. Abrams (University of Illinois), and one on "The Testing of Sewer Pipe," by E. S. Wallace (Kansas City) dealt with the manufacture of concrete pipe and the pressure and hydrostatic tests employed for such pipe. The concrete for this pipe is required to be watertight and impervious, but this is not necessary with drain tile, and in connection with the discussion on the subject there was exhibited some concrete tile made and used in Illinois. A paper by Paul Hansen, Engineer of the Illinois State Water Survey, outlined the work and activities of this department.

A paper by L. D. Jeffries, City Engineer of Peoria, dealt with the city bridge over the Illinois River, which has had many vicissitudes in its history. The most recent of these were the shifting of an abutment, and then the failure of the concrete arches due to scour under the piers. The bridge was finally completed in 1913.

In close relation to the matter of drainage was a paper by Lyman E. Cooley (Chicago) on "Removal of Dams from the Illinois River," although the main purpose of this removal is the establishment of navigation to the Mississippi. An interesting talk by Charles B. Burdick (Chicago) dealt with "The Ohio Floods in 1913," and as a supplement to this there was a paper by H. E. Babbitt (University of Illinois) on "Sanitary Measures following the Ohio River Floods."

The officers for 1914 are as follows: President, John J. Harman, Peoria; Vice-President, W. S. Shields, Chicago; Secretary, E. E. R. Tratman, Chicago. The next meeting will be held at Springfield, Ill., in January, 1915.

Canadian Railroad Casualties in 1913 resulted in the death of 643 persons and the injury of 2231, according to the annual report of the Board of Railway Commissioners, issued on Jan. 22. Of the killed, 39% were trespassers; and 21% were passengers.

NEWS NOTES

An Explosion in the Turbine Room of the "Mauretania" of the Cunard Line, at the dock in Liverpool, England, on Jan. 26, killed four men. According to cable dispatches, a large cylinder of gas, used for brazing, exploded.

Railroad Track Subsidence occurred on the Central R.R. of N. J., on the mountainside line which descends into the Wyoming Valley near Wilkes-Barre, Penn., on Jan. 2. About 200 ft. of double tracks sank from two to 10 ft., according to press dispatches, due to settlement of mine workings under the roadbed.

A Coal-Dust Explosion in the Rock Castle mine of the Davis Creek Coal Co., 35 miles south of Birmingham, Ala., resulted in the death of 12 men, on Jan. 10, according to press dispatches.

A Head Collision between a passenger train and a freight train on the Saginaw Division of the Michigan Central R.R., three miles north of Jackson, Mich., on Jan. 25, caused the death of four persons.

A Stairway and Floor Collapsed in a residence at Aurora, Ill., on Jan. 23, during a wedding celebration. According to press dispatches 22 of the 100 guests were injured and the bride and groom were removed to the hospital with serious injuries. The collapse occurred in the course of a dance.

Heavy Floods Stopped Railroad Traffic in southern and central California, for several days. The flooding was due to heavy rains which lasted from Jan. 24 to 27, inclusive. Seven persons were drowned and six trainloads of passengers were stalled near Los Angeles, due to washouts and landslides, in the most severe storm of the season. The greatest damage occurred at Santa Barbara.

A Railroad-Tunnel Fire in the tunnel under construction by the Carolina, Clinchfield & Ohio Ry. on its line between Dante, Va., and Elkhorn City, Ky., caused the death of 10 laborers, by suffocation, on Jan. 23. The men were working in the tunnel about 1¼ miles from the portal, when the timbering behind them caught fire. They extinguished the fire, but were overcome by the smoke.

The Chicago Garbage-Disposal Problem has been advanced one step by the decision of the city to purchase the plant of the Chicago Reduction Co. for $275,000. The plant has not been in operation for some time, the company's franchise having expired, and the city having refused to extend the franchise or to purchase the plant at the price demanded by the company. The city had commenced condemnation proceedings in order to acquire the plant, but had offered the company $275,000, which has now been acceptetd. Considerable expenditure will be required to put the plant in operating condition to take care of the garbage until the proposed incinerataing plants are built.

Phenomenal River Tides Observed—Exceptionally high tides in the Hudson River at Cornwall, N. Y., were recorded by the Board of Water Supply of New York City, Dec. 25-26. On Dec. 26, 1913, at 9:30 a.m., the elevation of high water was + 4.3, with respect to mean sea level at Sandy Hook, N. J. Drift material along the shore indicated that the preceding flood tide during the night of Dec. 25-26 was even higher, approximately to elevation + 5; but no reading was made to assure this. The wind was northeast; but its general direction in the Highlands was downstream, a condition which usually produces low tides. The presumption is that the effect of the storm on the ocean more than offset the effect on the river itself.

A high northeast wind on Jan. 12 and 13, 1914, was responsible for a minimum tide elevation of — 4.5, recorded at 7:45 a.m., Jan. 13. Therefore, within a few weeks a maximum range of tide of 8.8 ft. was recorded in the Hudson River about 60 miles from its mouth. For this information we are indebted to William B. Hoke, Assistant Engineer of the Board of Water Supply of the City of New York.

A Wood Water Tank of the water-works at Peotone, Ill., failed by bursting on Jan. 25. The failure is attributed to corrosion of the bands. The tank was 24 ft. high, 24 ft. diameter at bottom and 20 ft. at top, and stood on a brick tower 70 ft. high, having walls 28 in. to 20 in. thick. It was built in 1895. At the time of the accident the tank had 20 to 22 ft. of water. According to an eye-witness the break occurred at the bottom, the tank opening out like an umbrella and the staves being thrown in all directions, while the top or cover settled down upon the bottom. Nobody was

hurt, and the brick tower was not damaged. The village hall was practically destroyed, together with some frame sheds, and the pump house wrecked (but without damage to the engine or pump). For information we are indebted to A. E. Harken, president, and H. C. Reser, superintendent of waterworks.

Sewer-Gas Explosions in Detroit, Mich., on Jan. 28, did considerable damage to the sewer system, street pavements and buildings in a section of the city two miles in length. The first explosion occurred in the rear of the new Michigan Central R.R. depot, where the sewer is directly under the pavement, the earth having been excavated for a subway under the tracks, and was followed by a series in the sewer main under 18th St. as far as Buchanan St., and in some of the laterals leading into the 18th St. sewer main. Sections of the brick and wood-block pavements were torn up, two barns were wrecked, and many window panes were broken, along the line of the explosions. [Information from L. B. Alexander, 282 Glendale Ave., Detroit.]

A Railroad Bridge Collapsed on the New York, New Haven & Hartford R.R., about 17 miles south of Litchfield, Conn., on Jan. 24, under the stress of high water and ice in the Shepaug River. A new bridge, which will displace the old, is under construction across the Shepaug, near this point, and, according to press dispatches, the workmen there saw the old bridge (known as Judd's Bridge) collapse at 6 p.m. A train bound for New Preston, Conn., was stopped in time and the 80 passengers were transported to their destination by means of an eight-passenger construction automobile which was at the new bridge.

Bridge Reconstruction at Hamilton, Ohio, is to be based on a maximum flood flow of 110,000 to 120,000 cu.ft. per sec., according to a report of County Engineer Dillon to the County Commissioners. The smaller figure is the estimated discharge of the 1898 flood, while 120,000 is the approximate maximum discharge at a runoff rate equal to that of the 1913 flood, but with storage on Twin Creek as projected by Dayton; without such storage the flow would be some 20,000 cu.ft. greater. In rebuilding the High St. bridge, which was torn out by the flood last March, the waterway is to be enlarged by shifting the west abutment.

Appeal Decision on "Mushroom" Floor Patent—The patent decision of girderless floor systems of reinforced concrete, made March 29, 1912 ("Engineering News," April 18, 1912, p. 750), was affirmed on Jan. 19, 1914, by Judges Hook, Smith and Van Valkenburgh, in U. S. Circuit Court of Appeals, Eighth Circuit. The original decision, made by Judge Willard, in the U. S. District Court, was to the effect that a building, following the so called "umbrella" system of construction patented by Wm. Pierce Cowles, of Minneapolis, Minn., did not infringe the so called "mushroom system," as described in Patent No. 985,119, Feb 21, 1911, issued to C. A. P. Turner, of Minneapolis, Minn. The suit was brought by Mr. Turner against Moore & Scriver, the owners of the building in question.

The higher court decision not only affirms the lower court decision that the building does not infringe the Turner Patent No. 985,119, but further holds that the Turner patent merely brought together a number of hitherto individually existing elements into a single design, which does not constitute invention. In this connection Judge Hook, for the Court, said:

> The plaintiff merely selected and assembled old things in aggregation and pushed them with enterprise and publicity.

and Judge Van Valkenburgh, concurring, said:

> The constituent elements of the patent in suit were well known and performed the same functions in the same art, though not all disclosed in a single prior patent, publication or structure.

It is fair to state that Mr. Turner considers his Patent No. 985,119 a narrow patent and bases his broad claims for invention on Patent No. 1,003,384, Sept. 12, 1911.

The Steamer "Monroe" Was Sunk By Collision, on Jan. 31, with the "Nantucket" of the Merchants' & Miners' Line. The collision occurred about 50 miles off the Virginia Capes, in a dense fog, at 2 a.m. The "Monroe" of the Old Dominion Line, was struck on her starboard side at the forward overall gangway, just forward of the pilot house. According to the statement of Captain Johnson of the "Monroe":

> The "Monroe" proceeded to fill rapidly, and about four minutes after the collision, was nearly on her beam ends. One of the lifeboats on the starboard side was smashed in the collision and another was swamped while being launched. The remaining lifeboats on the starboard side were gotten away as quickly as possible; it being impossible, on account of the heavy list to starboard, to launch the port-side lifeboats. Not more than 10 minutes after the collision the "Monroe" foundered in about 15 fathoms of water, going down in approximately the same place at which the collision occurred. Many of the "Monroe's" crew and passengers were saved in her own boats, and others were picked up by boats from the "Nantucket," which was standing by and rendered all aid possible under the conditions. Nineteen passengers and 22 of the crew, were lost.
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> When all the rescues possible had been made and the injured bow of the "Nantucket" had been temporarily repaired with canvas, she started for Norfolk, Va., convoyed by the Old Dominion Liner "Hamilton."

According to press dispatches, Captain Berry of the "Nantucket" will be tried for negligence by the Board of Inspectors of the U. S. Steamboat Service at Philadelphia. Secretary Redfield, of the Department of Commerce, states that following a study of the evidence taken at the investigation at Norfolk, by the U. S. inspectors, instructions have been issued that charges be preferred against Captain Berry. The trial board will comprise David W. H. Howard, inspector of boilers, and Redford A. Sargent, inspector of hulls. Secretary Redfield announced that a special inquiry into the conditions surrounding the disaster will be conducted by a board comprising the Supervising Inspector-General of the Steamboat Service, and the Commissioner of Navigation.

The Luten Patents on Concrete Construction—A conference of those interested in the defense of suits brought for infringement of the Luten patents on concrete construction was held at Des Moines, Iowa, Jan. 23. The following account of the conference is taken from the Des Moines "Register and Leader":

> Attorneys, contractors and engineers from various parts of the United States who are interested in the eleven suits pending in federal courts for alleged infringement of the Luten patents in concrete construction are meeting in conference at the state house to unite in their fight against the monopoly, Daniel B. Luten, of Indianapolis, is said to have secured on certain types of concrete work.
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> The purpose of the conference is to give the men interested in each case advantage of the investigation of all the others in order to aid toward having the patents knocked out by the courts. As conditions now are, it is said that a concrete road cannot be built or a bridge constructed without infringing one of the 34 patents Luten holds on various curves, methods of reinforcing, and other essentials of road building.
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> The conference was called by Attorney General Cosson, who was authorized by the last general assembly to take a hand in fighting Luten and to intervene in behalf of the state in suits brought by Luten against contractors for infringement.
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> "I regard this matter of supreme importance," the attorney general said this morning. "The people are being forced to pay nearly 10% of all the money they are putting into concrete roads and bridges to pay for the Luten patent rights to the most elementary styles of building. The money to be expended for capitol extension is a mere bagatelle in comparison to the amount they are giving to Luten. We contend that most of these forms of constructions were used long before Luten ever thought of them. Today's conference is simply to bring about a general knowledge among the attorneys opposing Luten of the results obtained by the various investigations."
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> Attending the conference are Attorney General Cosson, Henry D. Sampson, assistant attorney general; Wallace R. Lane, of Chicago, patent expert employed by the state; H. C. Beard, chairman of the state highway commission; Thomas R. MacDonald, state highway engineer, and his assistants, F. R. White, George McCulloch and John Ames; John Dawson, attorney general of Kansas; W. S. Gearhart, state highway engineer of Kansas; Gilbert Haverfield, a Kansas City attorney; J. H. Swanson, a Madison, Wis., attorney; F. B. Torkleson, state engineer of Wisconsin; L. R. Nagele, expert of the Minnesota highway commission; J. G. Gould, of the Gould Construction Co., Davenport; B. C. Holcombe, of the firm of Carr & Carr, attorneys, St. Louis; Delbert Weaver, of Sioux City; J. B. and N. E. Marsh, of the Marsh Engineering Co., Des Moines.

PERSONALS

Mr. John T. Hopkins, former Assistant City Engineer of Utica, N. Y., is now Assistant City Engineer of Oswego, N. Y.

Mr. A. H. Decker has resigned as Engineer of Maintenance of Chicago & Northwestern Ry., Chicago, Ill., to engage in business as a contractor.

Dr. T. A. Jaggar, head of the department of geology at the Massachusetts Institute of Technology, is on his way to Japan to study the recent eruption on Sakura Island, which cost so many lives.

Mr. A. J. Davidson, Superintendent of the Oregon Electric Ry. and of the United Rys., Portland, Ore., has been appointed Superintendent of the Astoria division of the Spokane, Portland & Seattle Ry. also.

Mr. E. C. Hoffman, formerly Assistant Chief Engineer of the Cleveland, Youngstown & Eastern Ry., has opened an office in the Illuminating Bldg., Cleveland, Ohio, for general practice in civil engineering.

Mr. R. H. England, Vice-President and General Manager of the Central R.R. of Oregon, of Rochester, N. Y., and Union, Ore., has been appointed General Manager of the Kanawha & West Virginia R.R., Charleston, W. Va.

Mr. J. Beaumont, recently Signal Engineer of the Chicago Great Western Ry., Chicago, Ill., has been appointed Senior Signal Engineer of the third district of the Interstate Commerce Commission railway valuation board.

Mr. John I. Riegel, Assistant Engineer, Pennsylvania State Highway Department, has resigned to engage in private practice with offices at Scranton, Penn. He was formerly Assistant Engineer at Scranton of the Delaware & Hudson R.R.

Mr. T. H. Jordan, former Supervisor of Machinery Installation at the Pedro Miguel and Miraflores locks, Panama Canal, has accepted a position with Mr. H. M. Field, Contractor for 470 miles of railway construction in Honduras for the United Fruit Co.

Mr. Howard Elliott, Chairman of the Board of Directors of the New York, New Haven & Hartford R.R., has resigned as Chairman of the Board of Directors of the Boston & Maine R.R. in order that the two railways made be operated independently.

Messrs. T. H. Winchester, Assoc. M. Am. Soc. C. E., of Macon, Ga., and C. T. King have formed a partnership under the firm name of Winchester & King, with offices in Columbus, Ga., for the general practice of railway and hydro-electric engineering.

Mr. L. L. Newman, Assoc. Inst. E. E., with the Pennsylvania R.R., Pittsburgh, Penn., has been appointed Chief Engineer of the Birmingham Railway, Light & Power Co., Birmingham, Ala., to succeed Mr. Thomas R. H. Daniels, resigned, effective Feb. 15.

Mr. R. W. Willis, District Engineer of the Chicago, Burlington & Quincy R.R., at St. Louis, Mo., has been transferred to the Illinois district, with headquarters at Chicago, Ill., to succeed Mr. G. H. Bremner, M. Am. Soc. C. E., resigned, as noted in our issue of last week.

Mr. Hugh L. Cooper, M. Am. Soc. C. E., who since his completion of the works of the Mississippi River Power Co., at Keokuk, Iowa, has been on a long tour abroad, has returned to New York City, where he has opened offices at 101 Park Ave., for the general practice of hydraulic engineering.

Mr. Layton F. Smith, M. Am. Soc. C. E., for the past 10 years Engineer representative of the Trussed Concrete Steel Co., at Baltimore, Md., has opened an office at 513 North Charles St., Baltimore, for private practice as an Engineer-Architect, specializing in reinforced-concrete design and construction.

Mr. C. E. Burr, Superintendent of Delaware & Hudson R.R., at Carbondale, Penn., has been promoted to be General Superintendent of Transportation, at Albany, N. Y., succeeding Mr. C. E. McKim, assigned to other duties. Mr. Burr is succeeded at Carbondale by Mr. C. A. Morgan, formerly Trainmaster.

Mr. C. P. Collins, Assoc. M. Am. Soc. C. E., Civil and Sanitary Engineer, Johnstown, Penn., has been appointed Sanitary Engineer of Johnston to take charge of the preparation plans for the redesign of the sewerage and drainage system of the city. Mr. Collins was formerly Engineer of the Berwind-White Coal Mining Co., Winber, Penn.

Messrs. Hans E. Seidl and Walter E. Housman announce the formation of the partnership of Seidl & Housman, Consulting Engineers, 901 Swetland Bldg., Cleveland, Ohio. Mr. Seidl has been Consulting Engineer on public utility work for a number of years, and Mr. Housman has been for many years Power Expert with the United States Steel Corporation.

Messrs. Thomas M. Hurlburt, M. Am. Soc. C. E., formerly City Engineer of Portland, Ore., and Harold A. Rands, Assoc. M. Am. Soc. C. E., Hydraulic Engineer, of Oregon City, Ore., announce the formation of the partnership of Hurlburt & Rands, 505 Henry Bldg., Portland, Ore., for the general practice of civil engineering, specializing in municipal engineering and hydro-electric developments.

Mr. Harold Almert, Assoc. Am. Inst. E. E., for the past five years Manager of the department of examinations, and reports of H. M. Byllesby & Co., Chicago, Ill., has opened offices in The Rookery, 209 So. La Salle St., Chicago, for private practice. Mr. Almert has had 20 years' experience in the organization, financing, design, construction, operation, management and valuation of public utilities.

Mr. C. E. Carson, former Division Superintendent of the Chicago Great Western Ry., at St. Paul, Minn., has been appointed Superintendent of the Fort Dodge, Des Moines & Southern R.R., at Boone, Iowa. Mr. Carson's railway experience began in 1883 as a switchman with the Kansas, Fort Scott & Memphis Ry. at Kansas City, Mo. He has been Division Superintendent of the Missouri Pacific Ry., the Colorado & Southern Ry. and the National Rys. of Mexico.

Mr. Thomas H. Means, M. Am. Soc. C. E., of Symmes, Maxcy & Chandler, Agricultural Engineers, San Francisco, Calif., has been placed in charge of a New Orleans, La., office of the firm, which is to take charge of the agricultural development of 7500 acres of reclaimed land for the New Orleans Lake Shore Land Co. Several hundred acres of this land will be planted each year with citrus fruits. Mr. Means was formerly in charge of fieldwork for the Bureau of Soils, United States Department of Agriculture, on the Pacific coast.

Mr. Philip H. Dater, Assoc. M. Am. Soc. C. E., former Resident Engineer of the New York State Barge Canal at Little Falls, N. Y., and recently District Engineer of the United States Forest Service, with headquarters at Portland, Ore., has been appointed City Engineer of Portland. Mr. Dater is a native of New York State and a graduate of Williams College and the Massachusetts Institute of Technology, Class of 1898. He had been with the New York State Engineer department continuously since 1898, until his appointment to the Forest Service a year ago.

Mr. Arthur V. Ruggles, Assoc. M. Am. Soc. C. E., formerly Assistant Engineer of the Department of Water Supply, Gas and Electricity, New York City, recently with the sewer division of the Public Service Commission, First District, New York City, has been appointed Assistant Engineer of the Water Filtration Investigation bureau of the City of Cleveland, Ohio. Mr. Ruggles is a graduate of Dartmouth College and at one time was employed by Hazen & Whipple, Consulting Engineers, New York City, on water-filtration works. From 1906 to 1912 he was Assistant Engineer with the Board of Water Supply, New York City.

Mr. F. M. Patterson has been appointed District Engineer of the Missouri district of the Chicago, Burlington & Quincy R.R., St. Louis, Mo., to succeed Mr. R. W. Willis, transferred, as noted elsewhere. Mr. Patterson has been Assistant to the District Engineer at Chicago since 1909. He is a native of Iowa and attended the Iowa State University. In 1891 he began engineering work as a rodman with Chicago, Burlington & Quincy R.R. He was successively promoted to be instrumentman, Resident Engineer, Assistant Roadmaster, Roadmaster, Assistant Engineer, Division Engineer and Assistant to the District Engineer.

Mr. James M. Kurn has resigned as General Superintendent of the Northern district, Western lines of the Atchison, Topeka & Santa Fé Ry., La Junta, Colo., to become President of the Detroit, Toledo & Ironton Ry., Toledo, Ohio. Mr. Kurn was born in Michigan in 1870 and entered the railway service at 15 years of age as a telegraph operator on the Michigan Central R.R. Since 1887 he has served continuously with the Atchison, Topeka & Santa Fé Ry.; starting as a telegraph operator he was successively promoted in the operating department to be Superintendent of the Rio Grande division in 1905, and General Superintendent of the Western lines in 1910.

Mr. King G. Kellogg, for the past four years Chief Engineer of the E. E. Brownell Engineering Co., has resigned, effective Mar. 1, to devote his whole time to private practice, specializing in matters pertaining to the electrolytic corrosion of underground metallic structures from stray electric currents. Mr. Kellogg has had charge of the installation of a number of electrolytic mitigation systems and has made electrolysis examinations and tests in more than 50 cities throughout the country. For 16 years he was with the engineering department of the Peoples Gas Light & Coke Co., Chicago, Ill. Mr. Kellogg's headquarters will be at 1836 South 56th St., Philadelphia, Penn.

Mr. Arthur M. Shaw, M. Am. Soc. C. E., Engineer and Manager of the New Orleans Lake Shore Land Co., New Orleans, La., has been relieved of all work in connection with the agricultural development of the company's property, but will retain charge of the engineering and construction work. Mr. Shaw has opened an office in New Orleans for the general practice of civil engineering, specializing in the reclamation of large tracts of wet lands which require drainage by pumping. He was formerly in charge of drainage investigations in Louisiana under Mr. Charles G. Elliott, M. Am. Soc. C. E., Chief of the Bureau of Drainage Investigations of the United States Department of Agriculture.

Mr. Marshall B. Palmer, Assoc. M. Am. Soc. C. E., former Assistant Engineer, Syracuse, N. Y., Water Supply, has been promoted to be Deputy City Engineer. Mr. Palmer was born in Clinton, N. Y., in 1870, and graduated from Cornell University in civil engineering in 1895. For two years and a half he was Assistant Engineer on the New York State Canals. Later he was in charge of a survey party on the United States Deep Waterways Survey, and with J. H. Fuertes, M. Am. Soc. C. E., on the improvement of the Philadelphia, Penn., water supply. Subsequently he was Assistant

Engineer of the New York Central & Hudson River R.R., and with the New York State Engineer department on highways and on Barge Canal work.

Mr. Alfred Craven, M. Am. Soc. C. E., Chief Engineer of the Public Service Commission, First District, New York State, is now the highest paid official in the State and probably the highest salaried public-works engineer in this country. His salary has just been raised from $15,000 to $20,000 per annum. Mr. Craven is a graduate of the United States Naval Academy at Annapolis. He is a nephew of the famous Alfred W. Craven, the Chief Engineer of the first Croton Aqueduct of New York City, fourth President of the American Society of Civil Engineers. The salaries of Mr. Craven's engineering subordinates have also been materially increased. Mr. Robert Ridgway, M. Am. Soc. C. E., Engineer of Subway Construction, receives an increase from $10,000 to $12,000, and the Division Engineers of Subway Construction are to receive $7000 per annum, whereas the salaries for this grade have been from $4500 up. Similar increases are made in other grades.

Mr. Warren S. Palmer, General Manage of the Northwestern Pacific R.R., San Francisco, Calif., has been elected President, succeeding Mr. A. H. Payson. Mr. Palmer is an engineer. He graduated in civil engineering from the University of California in 1876 and began his engineering experience as an apprentice in the bridge and building department of the Central Pacific R.R. His subsequent experience included positions as journeyman bridge carpenter, draftsman, rodman, transitman and Chief of Party on location and construction. From 1885 to 1890 he was in charge of location parties on the Southern Pacific Ry., and a member of the firm of Palmer & Storey, Engineers and Contractors, of San Francisco. For 11 years following 1890 Mr. Palmer was Resident Engineer of Maintenance-of-way of the Western division of the Southern Pacific Ry., at Oakland, Calif., and during the last year was also Assistant Superintendent. From 1901 to 1905 he was Division Superintendent, first at Sacramento and then at Oakland; in June, 1905, he was promoted to be General Superintendent of the Northern district, at San Francisco. Since 1907 he has been General Manager of the Northwestern Pacific R.R., which is jointly owned and operated by the Southern Pacific Ry. and the Atchison, Topeka & Santa Fé Ry.

OBITUARY

I. N. Chapman, City Engineer of Alameda, Calif., died Jan. 24.

Byron E. Merwin, General Superintendent of the Aurora, Elgin & Chicago R.R., died Jan. 23, at his home in Wheaton, Ill., from cancer. He was 51 years old.

Peter Bates, an oldtime engineer of western Pennsylvania, died Jan. 8, at the home of his son, Mr. N. B. Bates, of Pittsburgh, Penn. From 1865 to 1874 he was Chief Engineer of the water-works of Allegheny, Penn.

Neil W. Snow, former Division Superintendent and afterward Assistant to the General Superintendent of the Michigan Central R.R., died in Detroit, Mich., Jan. 10. He was 39 years old and had retired from railway work four years ago.

Charles F. Prichard, Vice-President and General Manager of the Lynn (Mass.) Gas & Electric Co., died at his home in Lynn, Jan. 21, from acute indigestion. He was born in Marblehead, Mass., in 1856, and graduated from the Massachusetts Institute of Technology in mechanical engineering in 1876. He had been connected with the Lynn gas-works since 1883

Ricardo Manual Arango, M. Am. Soc. C. E., Chief Engineer of the Republic of Panama, died at his home in Panama City, Jan. 24. He was a native of Panama, where he was born in 1864. In 1887 he graduated from Rensselaer Polytechnic Institute, and since then had been employed in various capacities in Panama; for a time he was with the city waterworks department, later in private practice, and for a time with the Isthmian Canal Commission.

Thomas M. McLeod, a contractor of New York City, died Jan. 22 at the St. Nicholas Hospital, Toronto, Ont. He had just completed a large construction contract for the city of Toronto, in which he was associated with Mr. Ogden Merrill, of New York City. He was born at Georgetown, Prince Edward Island, 46 years ago, and graduated from McGill University at Montreal, Que., in 1893. For several years he was engaged in contract work in New York City and vicinity, including subway excavation, reinforced-concrete conduits for the Jersey City water-works, Grand Central Terminal improvements and the Manhattan approach of the Williamsburg bridge. Mr. McLeod possessed not only a genial and likable disposition, but was much beloved because of his staunch integrity and fidelity to his friends. He is survived by his mother, four brothers and two sisters. [Contributed by Chas. W. Bance, Toronto, Ont.]

William Cooper, Director of Buildings and Equipment of the East Pittsburgh, Penn., works of the Westinghouse Electric & Manufacturing Co., died at his home in Wilkinsburg, Penn., Jan. 23, from peritonitis. He was born near Watertown, N. Y., in 1861. He attended Cornell University and began work in charge of the power plant of a cheese-manufacturing company. At the age of 25 years he went to Ottumwa, Iowa, where for a time he was employed by an automatic screw-machine manufactory. Soon afterward he embarked in business for himself in an undertaking to develop a method for using compressed air for tractive power on street cars. Subsequently he was Master Mechanic and Chief Engineer of the Twin City Rapid Transit Co., at Minneapolis, Minn. In 1894 Mr. Cooper entered the employ of the General Electric Co., Schenectady, N. Y., specializing in the then new and expanding field of electric railway engineering. After three years at Schenectady he became associated with the firm of Blood & Hale, Consulting Engineers, Boston, Mass., but shortly afterward accepted the position of General Superintendent of the Bullock Electric & Manufacturing Co., Cincinnati, Ohio. In 1904 he entered the employ of the Westinghouse Electric & Manufacturing Co., in the railway engineering department, where he subsequently had an active participation in the design and manufacture of the electric locomotives for the New York, New Haven & Hartford R.R., the Pennsylvania R.R. and other notable electric railway equipment. Two years ago he was made Director of Buildings and Equipment, and in this capacity had charge of the recent remodeling of the power plant at the East Pittsburgh works. He is survived by a widow, who was Miss Ida J. Arnold, of Rockford, Ill.

ENGINEERING SOCIETIES

COMING MEETINGS

CONNECTICUT SOCIETY OF CIVIL ENGINEERS.
Feb. 10-11. Annual meeting at Hartford, Conn. Secy., J. Frederick Jackson, Box 1304, New Haven, Conn.

OHIO ENGINEERING SOCIETY.
Feb. 11-14. Annual meeting at Columbus, Ohio. Secy., D. W. Seitz, Columbus, Ohio.

NATIONAL CONFERENCE ON CONCRETE ROAD BUILDING.
Feb. 12-14. Meeting at Chicago, Ill. Secy., J. P. Beck, 72 W. Adams St., Chicago, Ill.

NORTH DAKOTA SOCIETY OF ENGINEERS.
Feb. 12-13. Annual convention at Fargo, N. D. Secy., E. F. Chandler, University of North Dakota, University, N. D.

AMERICAN CONCRETE INSTITUTE.
Feb. 16-20. Annual meeting in Chicago, Ill. Secy., E. E. Krauss, Harrison Building, Philadelphia.

IOWA ENGINEERING SOCIETY.
Feb. 18-20. Annual meeting at Council Bluffs, Iowa. Secy., S. M. Woodward, Iowa City, Iowa.

MINNESOTA ENGINEERS' AND SURVEYORS' SOCIETY.
Feb. 24-25. Annual meeting at St. Paul, Minn. President, Wm. Danforth, 411 Hackney Building, St. Paul, Minn.

INDIANA SANITARY AND WATER SUPPLY ASSOCIATION.
Feb. 26-27. Annual meeting at Indianapolis, Ind. Secy., Dr. W. F. King, Indianapolis.

HIGHWAY ENGINEERS' ASSOCIATION OF MISSOURI.
Feb. 26-28. Annual meeting at St. Joseph. Secy., Ray L. Gargill, St. Joseph, Mo.

VERMONT SOCIETY OF ENGINEERS.
Mar. 12. Annual meeting at Burlington, Vt. Secy., Geo. A. Reed, Barre, Vt.

Colorado Electric Light, Power and Railway Association—The officers elected for 1914 were as follows: President, W. C. Sterne (Summit County Power Co.); Vice-President, W. F. Raber (Arkansas Valley Ry., Light & Power Co.), and Secretary, T. F. Kennedy (Denver Gas & Electric Light Co.), Denver, Colo.

General Contractors' Association—The officers elected for 1914 are as follows: President, Franklin Remington (Foundation Co.); 1st Vice-President, Edward S. Skillin (Snare & Triest Co.); 2d Vice-President, Daniel A. Garber (Northeastern Construction Co.); Treasurer, Wm. P. Schmuck (Degnon Contracting Co.); Secretary, C. A. Crane, Room 932, Emigrant Bank Building, 51 Chambers St., New York City.

Engineers' Society of Western Pennsylvania—The annual meeting of the Mechanical Section was held in the Society rooms on Feb. 3, 1914. The address of the retiring president (Geo. H. Neilson) was "Crucible Steel: Some Interesting Facts." The Secretary of the Society is Elmer K. Hiles, Oliver Building, Pittsburgh, Penn.

Montana Institute of Municipal Engineers—At the annual meeting held at Great Falls, Mont., Jan. 19-21, the following officers were elected: President, F. C. Snow, of Bozeman; Secretary, C. C. Widener, Bozeman, Mont.

Compressed Gas Manufacturers' Association—At the first annual meeting held in New York, Jan. 29, the following officers were elected for 1914: President, Dr. Hugo Lieber; 1st Vice-President, J. B. Greiner; 2d Vice-President, A. Cressy Morrison; Secretary, John J. O'Rorke, 25 Madison Ave., New York City.

American Society of Civil Engineers—The 46th annual convention will be held in Baltimore, Md., during the first week of June. The Society will be the guest of the Engineers' Club of Baltimore.

Oklahoma Engineering Society—At the seventh annual meeting, held at Oklahoma City, Dec. 26-27, the following officers were elected: President, W. L. Benham; Secretary, H. V. Hinckley, 1018 N. Harvey St., Oklahoma City, Okla.

Connecticut Society of Civil Engineers—The 30th annual meeting of the Society will be held at Hartford, Conn., Feb. 10-11. Eight committees are expected to present their reports and a number of papers will be read. The annual dinner will be held at the Hartford Club, on Feb. 10. The Secretary is J. Frederick Jackson, New Haven, Conn.

Engineers and Architects Club of Louisville, Ky.—At the recent annual meeting the following officers were elected for 1914: President, Malcolm Elliott; Vice-President, Samuel Riddle; Secretary, Pierce Butler, 1412 Starks Building, Louisville, Ky.

Western Society of Engineers—At the meeting held in the Society's rooms at Chicago on Jan. 19, an interesting paper on "Engineering Lessons from the Ohio Floods" was presented by John W. Alvord. Reference was made to the flood prevention and flood protection investigations made at Columbus, Ohio, and other cities, and was illustrated by a number of lantern slides showing the engineers' plans and views of the flooded district. The hydraulic, sanitary and municipal section of the Society has elected officers as follows: Chairman, W. D. Gerber; Vice-Chairman, G. C. D. Lenth, both of Chicago.

National Conference on Concrete Road Building—The program of the Conference has been divided into four sessions at which 15 committee reports and seven addresses will be presented. W. F. M. Goss, Dean of the College of Engineering, University of Illinois, will preside over the first and fourth sessions; A. N. Johnson, State Highway Engineer of Illinois, over the second; and Ira O. Baker, Professor of Civil Engineering, University of Illinois, over the third session. Among the 15 committees to report, are the following with their chairmen: "Contraction and Expansion of Concrete Roads," R. J. Wig (Bureau of Standards); "Aggregates for Concrete Roads," Sanford E. Thompson (Newton Highlands, Mass.); "Reinforcement of Concrete Roads," T. H. McDonald (State Highway Engineer, Ames, Iowa); "Finishing and Curing Concrete Road Surfaces," F. E. Turneaure (Dean of the College of Engineering, University of Wisconsin); "Cost of Constructing Concrete Roads," A. N. Johnson; "Proportion and Consistency of Materials for Concrete Roads," C. U. Boley (City Engineer, Sheboygan, Wis.).

American Electric Railway Association—The mid-year conference of this and the allied associations in the accounting, engineering, traffic, claims, and manufacturing fields was held in New York City, Jan. 28-31. This time was taken up with committee meetings, except for two sessions on Jan. 30 given up to general papers. There was a banquet on Jan. 29, with addresses by C. F. Hawley, President of the American Electric Railway Manufacturers Association, G. E. Tripp, Chairman of the Board of Directors, Westinghouse Electric & Mfg. Co., and H. W. Anderson, Vice-President and General Counsel, Virginia Railway & Power Co.

At the morning session of the general conference on Jan. 30, a paper was presented by Martin Schreiber of the Public Service Railway, Newark, N. J., on "The Value of Company Sections." This was a review of the value of company sections to the companies, to the individual employees, and to the association. He argued that if the association was to be truly representative of the industry it must have a larger individual membership among the employees of the railways.

The second paper was a report of the Special Joint Committee on Joint Use of Poles, presented by W. J. Harvie, of J. G. White Co., Chairman. At the last annual convention, this committee had presented specifications for joint use and a recommended form of agreement, but the convention had referred them back for the committee to ascertain the sentiment of member companies. The committee reported that it had received replies from 109 member companies; of these 77 approved the specifications and agreement and 32 criticized. The committee believed that the criticisms might be explained away when it was realized that the agreement and specifications were general recommendations, various sections of which were to be rewritten according to local [illegible].

Hon. Halford Erickson, Wisconsin Railroad Commission, addressed the Association on "Economic Aspects of Regulation Compared with Profit-Sharing with Municipalities." "Profit Sharing" he defined as including a large variety of schemes for securing so called "home-rule" or local regulation of utilities under franchises and ordinances. Reversion to this earlier sort of regulation would be one-sided—looking only to the protection of the public. The trend of recent regulation by state commission looks also to the protection of the utility—a step that would be recognized as necessary for adequate service and stability of benefit to the community. He believed that, with either State or local regulation, a Commission would be necessary and that the State Commission would be much more economical than a multitude of local Commissions. The profit-sharing feature of franchises and contracts really was a tax over and above the regular taxes and, therefore, an undue burden on operations that might adversely affect the quality of service which a company could give the public. He admitted that courts hold these payments to be in the nature of a toll or rental and not a franchise tax, but the effect was the same. He believed that the most desirable form of franchise contract was the indeterminate-permit type. He saw, in all regulation, great danger of taking from the companies incentive to continued efforts for efficiency and economy. Therefore, he believed that it would be advisable soon to work out some sort of efficiency reward. This could be secured by adjustment of rates only after considerable intervals, or by sharing the excess earnings above a certain amount between the municipality and the company, or by some of the so called sliding-scale schemes, whereby a reduction in rates permitted an increase in dividends.

For the second session, F. W. Hilde, General Manager of the Portland (Oregon) Railway, Light & Power Co., contributed a paper on "The Effect of Rate of Fare on Riding Habit." This was read by Prof. A. S. Ritchey. It was a discussion of the common allegation, as it applies to street railways, that business is stimulated by a reduction in price. Mr. Hilde believed that the relative order of regulation measures should be regarding safety, service and rates. He admitted that, generally in business, the stimulus was directly in proportion to the unit reduction. There was a certain limitation to this law, however, in that small unit prices required a much larger percentage reduction than large units of price to have appreciable effect. Universal transfers and long extensions he held were equivalent to fare reduction and have some stimulating effect, more, even, than the direct reduction of collected fares. A convenient expression for riding habit given was "revenue rides per annum divided by population." For San Francisco, the maximum city in the country in riding habit, the figure was 375. Philadelphia showed the smallest number, or 237. Glasgow was the leading British city in riding habit with a figure of 237, and Leicester was the smallest with 125. The study of the riding habits of different cities showed that low rates of fare were not important. In Cleveland and Toledo, for instance, the riding habit is not high; Cleveland is midway in the list of American cities and Toledo is near the bottom. The use of six or seven tickets for a quarter in several American cities was studied and it was found that in every case no stimulation of riding habit was found over the natural increase due to population and certain other obvious effects.

In the discussion of the paper, specific figures of similar studies in various cities bearing out the contention of Mr. Hild were presented by L. R. Nash, of Stone & Webster Engineering Corporation, Boston, Mass., R. B. Stearns, of Milwaukee, and F. R. Coates, of Toledo.

The last paper of the convention was "Present-Day Influence of Labor on Legislation," by C. L. S. Tingley, Vice-President of the American Railways Co., Philadelphia.

Index Now Ready

The Index to Vol. 70 of ENGINEERING NEWS has been printed and will be mailed this week to all subscribers who have requested a copy in accordance with the notice printed in our issue of Jan. 8. As some readers may have overlooked the notice, we repeat here that a copy of the Index will be sent to any reader desiring it who sends a request for it to the Subscription Department.